

The University of Chicago

THE AGRICULTURAL AND FORESTRY
LAND-USE OF SZECHUAN BASIN

A DISSERTATION SUBMITTED TO THE FACULTY
OF THE DIVISION OF THE PHYSICAL SCIENCES
IN CANDIDACY FOR THE DEGREE OF DOCTOR
OF PHILOSOPHY

DEPARTMENT OF GEOGRAPHY
DECEMBER, 1942

By
CHARLES Y. HU

CHICAGO, ILLINOIS

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PREFACE

Ever since the writer interested himself in the study of land-use, he has been eager to prepare a comprehensive account on the conditions of land-use in his native area, the Szechuan Basin. The present study is a result of that intention and it represents one of the series of studies the writer has planned along that line. The investigation, as herewith presented, is limited to an analysis of the agricultural and forestry land-use of the Basin.

In addition to numerous journeys in the Szechuan Basin and to the many observations made in previous years, the writer undertook an air-reconnaissance flight over the Basin--from Hankow via Chungking to Chengtu--during the early summer of 1934. Since then, the writer has been in constant touch with the area by correspondence and has collected considerable amounts of valuable and elusive data from numerous sources. Moreover, every effort has been made and every caution taken to bring the data employed in the dissertation up to date from all the reliable sources available. It is, however, deeply regretted that the serious handicaps of the war have prevented the writer from making more recent reconnaissance surveys in the Basin.

Many friends and former colleagues have contributed to the completion of the present study. To Dr. H. R. Wei, Dean of the College of Science, and Chairman of the Department of Physics at the University of Nanking, (now at Chengtu); Professor C. S. Fang, Department of Botany of the College of Agriculture of the same institution; and Professor H. Y. Hu, Acting Chairman and Professor of the Department of Geography, National Central University, Chungking, the writer wishes to express his deep thanks and sincere gratitude for their generous assistance in securing valuable data and in furnishing much-needed documents. Grateful acknowledgments are also due to the writer's close friend, the Honorable T. S. Wang, Member of the National Senate (Legislative Yuan) of China, for having his efficient clerical staff compile and copy large amounts of valuable data from unpublished sources. To all these gentlemen, the writer wishes to present his deep thanks.

Mr. M. C. Swen, Director of the Department of Cinematography of the University of Nanking, assisted the writer by supplying from his personal collection a number of photographs pertaining to the landscapes of the Basin. Mr. J. Thorp, Senior soil scientist of the United States Soil Survey and formerly of the Geological Survey of China, was most kind in furnishing many excellent photographs which he took during his visit to the Basin in 1935. Mr. Thorp also has generously permitted the writer to use part of his generalized soil map of China. To both Mr. Swen and Mr. Thorp the writer wishes to express his sincere thanks and gratitude.

Above all, the writer is greatly indebted to Dr. J. L. Buck, his teacher and friend at the College of Agriculture of the University of Nanking, for encouragement that led to study in the United States.

The writer wishes to express his deep appreciation and sincere gratitude to professors H. H. Barrows, Charles C. Colby, Wellington D. Jones, and Robert S. Platt of the staff of the Department of Geography at the University of Chicago for the generous assistance and valuable guidance they have given in the preparation of the manuscript. The writer is under special obligation to Professor Colby for help in organizing and editing the manuscript into its final form. Special acknowledgment also is due to Professor H. M. Leppard for his assistance in the construction and printing of many of the maps, charts, and photographs. In addition, the writer wishes to thank Dr. Charles Olmsted of the Department of Botany at the University of Chicago for his interesting instruction and stimulating viewpoints in connection with problems of land-use. It must be made perfectly clear, however, that none of these men mentioned above shares in any manner or is in any way responsible for whatever errors and shortcomings may appear in the present manuscript. For these, the writer, and the writer alone, is fully responsible.

Above all, as in everything else, the writer owes his greatest debt to his wife for her loyal support and unfailing encouragement without which the present work could never have been completed.

Charles Y. Hu

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CHAPTER I

SZETCHUAN BASIN IN TRANSITION

The primary objective of this dissertation is a critical geographical evaluation of the agricultural and forestry land use of Szechuan Basin. Throughout the study emphasis has been placed on first, a presentation of the most characteristic features of the Basin, and second, a correlation of cultural life, especially agricultural and forestry land use practices, with the major natural elements of the Basin. Attention also is directed to the unique qualities which made the Basin a vital unit in China's resistance to invasion by the Japanese and to the growing significance in China's evolving economy.

Szechuan Basin is one of the large and distinctive regions of China. Surrounded by lofty mountain ranges and unique in its cultural development, the Basin is a clear-cut geographic unit. It has a mild, humid climate, fertile soil, a diversity of agricultural products, abundant mineral resources, and numerous important forestry, horticultural, and animal products. Szechuan Basin may be justly said to be the most self-sufficient region of China. In fact, by virtue of the great diversity of its products, the Basin is almost a miniature model of all China. It is an empire within an empire.

Szechuan Basin is an ancient land from the standpoint of human occupation and utilization. Aside from the upper Yellow River Valley provinces, Szechuan Basin was the earliest area of China to be settled. The first organized Chinese migration into the Basin took place in the fifth century B.C. As early as the feudal Chin period (360-251 B.C.), the Basin had already begun to assume considerable economic-geographic importance in China's national life, a role which has increased in importance since that time.

On account of its central geographic position (in relation to the surrounding land-locked provinces of southwest China), the Basin has received greatly diversified groups of emigrants from

the neighboring provinces of interior China. The influx of these heterogeneous groups of immigrants brought with it many ideas and practices to help in the adjustment of the people to their new environment, particularly in connection with agricultural and forestry land use. This fact helps to explain the present heterogeneity of the agricultural landscape of the Basin.

Agriculture and forestry are the outstanding features of the economy of the Szechuan Basin. Approximately 85 per cent of the people gain their livelihood from agricultural pursuits. In terms of exports from the Basin, however, the leading item, Tung oil, is a forest product. Most of the other exports are either agricultural or forestry products.

In so far as agricultural land use is concerned, nowhere else in China except in Szechuan Basin does one find terraced fields so extensively, elaborately, and finely made, and irrigation systems so greatly diversified and ingeniously devised. The Basin is almost literally a country of "millions of minute steps" and a land of "thousands of small ditches." The terraced fields and the irrigation ditches, together with the hard-working peasantry have helped to transform the otherwise hostile rugged Szechuan Basin into a smiling garden.

Other unique features of the Basin's agricultural land use include the age-old but the recently much publicized Tung Shui Tien (winter storage water field) system; the cultivation of Tsai Seng Tao (double-growth) variety rice; the numerous special methods of soil culture, fertilization, composting, and crop rotations; and the various elaborate systems of inter-culture and synchronization of crops.

As has been implied, the Basin is a natural unit. Its combination of surface, climate, soil, and drainage is unlike that of any other part of China. In large measure, the interior of the Basin within the mountainous border is made up of hill country which varies from hilly areas of low relief in the south to the fairly high parallel anticlinal ridges in the east and to a border of complex hills at the north. Near the western edge of the Basin, the hills give way to the Chengtu Plain, a broad piedmont alluvial plain, the most productive part of the Basin.

Climatically, the Basin has a phase of the "humid sub-tropical" type of climate.¹ The Basin extends from latitude 28

¹G. Trewartha, An Introduction to Weather and Climate, Plate I, 1937.

to 33 degrees North. It has a mild winter with little or no frost or snow, and a warm summer. The average annual precipitation in most parts of the Basin is about 34 inches, with some rain in every month. The summer months, however, have more rain than the winter months. There is almost continuous high relative humidity, and wind, on the whole, is conspicuous by its absence.¹

The Basin is drained and practically bisected by the Yangtse River. The Yangtse enters the Basin at the southwest and leaves it at the northeast. Within the Basin, the Yangtse is fed by three sets of tributaries--one from the north, one from the northwest, and one from the south. The northern and northwestern tributaries rise in the high mountains which rim the north and northwestern part of the Basin, and their flow greatly exceeds that of the southern set of tributaries. On the whole, the Basin, with its hilly terrain, is well drained. In fact, problems of erosion are much more acute than problems of drainage.

Generally speaking, the soils of the Basin fall into two main groups. One is the extraordinarily fertile soil of the Chengtu Plain and the other is the moderately fertile soil known as the "purple-brown (forest)" type,² which dominates in most parts of the Basin. The Chengtu Plain soil is derived from the alluvial deposits of the Min River. The richness of this soil is greatly enhanced by its annual renewal through the overflow of the Min. The Chengtu Plain soil is noted for its very dark color, great depth, and rich humus content. The "purple-brown" type, developed in deciduous forests growing on parental material derived from the friable, cretaceous shales and sandstones, is only moderately fertile for agricultural use. This soil is noted especially for its loose texture and easily-eroded qualities. Moreover, this soil has a peculiar characteristic of absorbing and losing (evaporating) water quickly.³ One evening's thick fog may cause the whole depth of the surface soil to be thoroughly moistened and saturated, whereas a continuation of clear sky for several days may cause the soil to dry up and crack. In general, the "purple-

¹Bureau of Reconstruction, Annual weather report (Szechuan, 1939), p. 29.

²J. Thorp, Soil Geography of China (1936), p. 200.

³H. Yu, "A Preliminary Observation of the Purple-Brown Soils of Szechuan Province," Soils Quarterly, January, 1941, p. 39.

brown" type soil is rich in mineral foods but rather low in humus content and is shallower in depths than the soils of the Chengtu Plain. However, on account of the hilly nature of most parts of the Basin, soil characteristics vary greatly in different local areas.

In many ways, the distribution of agriculture and forestry and the features associated with these uses of the land are related to and conditioned by one or more of the natural elements characterized in the foregoing paragraphs. Forests mantle the mountain slope, and tree crops are characteristic of many of the hillsides. Agriculture dominates the Chengtu Plain, and is conspicuous along the numerous valley floors and on the terraced hills.

Of all the natural elements at work in the Basin, topography is a highly important factor that affects the agriculture land use and other forms of cultural life, and the adjustment to this natural element is especially conspicuous. First of all, the close correlation between the cultivated-land index and the topography is most striking. In general, there is a consistent tendency for the cultivated-land index, and the population patterns as well, to decrease from the center of the Basin to the peripheral highlands. Second, the adjustment of the Basin's settlement forms to the topography is outstanding. As in most parts of China, about 85 per cent of the population of Szechuan Basin is rural. But unlike any other part of China, there are comparatively few large villages and nuclear hamlets, with the exception of the Hsien¹ capitals. This remarkable fact is largely a result of the rugged and extremely dissected topography of the Basin. The settlement forms have had to adjust to the local topography. This is particularly true in the eastern and northern parts of the Basin.

In the agricultural adjustment to water resources and drainage patterns, the following examples may be noted. First, by seizing the torrential flow of the Min River, the Basin has built not only the oldest but also the most successful and easily-maintained irrigation system of all China. This system has freed the Chengtu Plain from the hazard of floods and droughts, and has insured the unbroken agricultural prosperity of the Basin. This

¹Hsien or district in China corresponds somewhat to the county unit of the United States.

success is evidenced by the remarkable fact that during the past twenty-two hundred years, ever since this irrigation work was built, there have been only six minor floods in the Plain.

The presence of innumerable other irrigation projects, greatly diversified in construction and surprisingly adaptable to the local topography and source of water supply, bears witness to the painstaking and extensive adjustments the Basin has made to the vital problem of water supply.

A second adjustment to water resource lies in the fact that even with its limited available technological knowledge, the Basin has made good use of many of its numerous streams. By canalization, damming, and other devices, the navigability of these streams has been greatly increased. Especially the successful negotiation by steamboats of the bottle-neck (gorges) of the mighty Yangtse has greatly tempered the continental position and the land-locked character of the Basin. These achievements, in turn, have facilitated the movement of the bulky agricultural and forestry products among the various areas both within and without the Basin.

The localization of the Basin's urban units on the terraces and along the banks of the principal rivers is a third example of adjustment, partly to topography and partly to river transportation.

Among the climatic adjustments, the architecture of the Basin (characterized by the projecting eaves, recurved roofs, and elaborate roof ornaments) is closely correlated to the absence of wind and snow and the extended misty rain-season of the Basin.

The practice of digging in the soft, friable, cretaceous bed rock, in order to hasten weathering and soil formation for agricultural land use, represents one of the most astounding examples of soil culture and environmental adjustment in the Basin.

As a result of the abundant growth of bamboo in the Basin, an interesting adjustment to vegetation has taken place. Nowhere else in China except in the Basin does one find widespread use of bamboo. In addition to the large number of articles of furniture, household tools, and utensils of various kinds which are made from this material, even the great engineering construction works, including the important irrigation systems, bridges, and brine-salt mining equipment are all made of bamboo. It was once estimated that bamboo is used for six hundred different purposes in the Basin. Here people are truly in the "bamboo age."

The Basin has often been referred to by western writers as "the Eden of the Flowery Republic," or the "Garden of Asia." By the Chinese themselves, it is popularly called the "Tien Fu," which literally means the "Treasury of Heaven." Although these names may appear exaggerated, they do suggest the agricultural richness and the amazing diversity of the products of the Basin. Normally, Szechuan Basin leads all China in the production of corn and rape. It holds second place as a producer of rice, potatoes, and silk; fifth place, as a producer of wheat; and sixth, as a producer of millet, kaoliang, and soy beans. The Basin has been for decades unchallenged as a producer of such internationally known products as tung oil, bristles, herbs, Cho Tsai (pickled vegetables), Wu Pei Tze, and Nanmu (lumber).

The agricultural richness of the Basin and the important role it now plays in China's present war effort are demonstrated by one significant fact. The Basin alone contributes about 60 per cent of the total food supply for the entire Chinese fighting force, comprising over five million men. The Basin is truly a granary of all free China.

In forestry land use, the Basin normally produces about a third of the total annual production of tung oil for all China. This product constitutes a critical cash crop for farmers in many parts of the Basin, particularly in the hilly east and southeast. At present tung oil occupies a vitally important position in the export trade of the Basin. It, alone, comprised about 65 per cent of the Basin's total export trade in 1940.

Another important forestry product of the Basin is white wax. The Basin normally produces over 90 per cent of the total white wax of China. Although the economic value of this unique forestry product is not great, the spectacular snow-white color of the wax tree in the late Autumn adds much to the picturesqueness of the Basin's agricultural landscape.

Lacquer derived from the varnish tree, has been famous in the Basin ever since the Han dynasty (206 B.C. to 220 A.D.). It still remains one of the Basin's most reputed products.

The variety and abundance of strategic minerals in the Basin is second only to its richness in agricultural and forestry products. Today the Basin leads all China in the production of brine salt. Its iron reserve ranks second and its coal reserve ranks third in the country, but it is at present the leading

producer of both these key minerals among all the provinces of free China.

While it is true that Szechuan Basin is undoubtedly the most self-sufficient and prosperous agricultural region of China, many phases of its present agricultural and forestry land use cannot be said to be wholly satisfactory from the standpoint of modern technology and scientific development. As a matter of fact, the backwardness of some of the practices is appalling. Drastic measures of improvement are urgently needed.

The efficiency of the Basin's present agricultural land use has been handicapped greatly by many natural and cultural factors. Among these are the traditional "Tung Shui Tien" system; the undependable nature and marginal character of the hilly agriculture in many parts of the Basin; the presence of large tracts of unreclaimed vacant land (particularly at the peripheral areas of the Basin); ignorance of modern scientific methods of seed selection and plant-breeding (from the irrigated alluvial plain rice to the small millet of the non-irrigated eroded soils of the upper hills); the insufficiency and failure of cotton-culture in many parts of the Basin; the periodic or aperiodic famine in the more hilly areas due to the lack of the more drought-resistant crops; the serious nature of soil-creep in many hilly areas; the failure to modernize silk-culture; the failure to cultivate and to experiment with native herbs; and above all, the lack of satisfactory and efficient irrigation system in many terraced fields of the more hilly areas.

In forestry land use, the most noticeable difficulties are: the lack of long-range and far-sighted forestry policy and lumber exploitation; the failure to cultivate and to experiment with tung trees; the absence of well-organized and modern-equipped plantations in tung tree production; the lack of standardization of tung tree products; and the serious hazards (due to long and difficult hauling) of transporting the wax-insects in the white-wax tree industry.

Transportation both within and without the Basin has been made difficult by the swift flow of many of the streams and the ruggedness of the topography. Among all the regional problems of Szechuan Basin, none is more important and more acute than the issue of transportation. The solution of this problem will promote the efficiency of agricultural and forestry as well as other forms of land use in the Basin.

As a result of the recent barbaric Japanese invasion of China and the great influx of modern people and ideas from down-river into the Basin during the past few years, a renaissance has begun in Szechuan Basin. The Basin is now undergoing an economic awakening. It is in a state of rapid transition, induced and intensified by the exigencies of the war.

Since the migration of the National government into the Basin, every possible means has been utilized and every feasible plan is being drawn up to increase the efficiency of land use in the Basin. Mention may be made of a few striking examples.

In agricultural land use, various measures have been devised to cope with the inefficient traditional Tung Shui Tien field system; the acreage in Tsai Seng Tao variety rice has been extended; cotton culture has been expanded; the cultivated acreage of herb plants has been increased; more modern sugar refineries have been built, experimental stations have been established, and a number of new varieties of sugar cane have been introduced; silk-culture has been organized and operated on a more scientific basis; a number of tea-growers' cooperatives have been found recently; and above all, the practices in fertilization, terracing, erosion control, and irrigation works have been improved.

With the introduction of more modern methods of processing, the numerous agricultural and forestry products of the Basin are being put into more efficient utilization. The increasing manufacture of alcohol and wines from grains, the making of charcoal from wood, and the preparation of synthetic gasoline from tung oil are notable examples. These innovations not only meet the various emergent war needs, especially that of fuel supply, but also help to solve the still difficult transportation problem by transforming the bulky agricultural and forestry products into lighter and more transportable forms.

In forestry land use, significant improvements have already taken place. A number of large corporations, financed either by government or private interests, have recently organized to survey intensively and to exploit systematically the rich forestry resources of the Basin. Numerous attempts have been made to improve tung tree production, including the establishment of more tung tree plantations and experimental stations, the supply of modern equipment, and the efficient organization of marketing facilities. Besides, the recent completion of the west branch of

the Szechuan-Yunnan highway will relieve to a considerable degree the traditional difficulty of transporting the wax insects for the white-wax tree industry.

In both mining and manufacturing, rapid progress has also been made. During the past few years, the Basin's coal production has been increased 400 per cent, iron production 300 per cent, and placer mining 200 per cent. Besides, the Basin is rapidly developing into a new industrial center of free China. It is now the home of over 61 per cent of free China's machine industry. At present the Basin accounts for about 40 per cent of the total manufacturing capacity of all free China.

Even in the most chronic and difficult problem of transportation land use, rapid progress is being made. Numerous commercial air lines have been inaugurated since 1932, many railways (some of them already under construction) have been projected; and the highway network of the Basin has been partly completed. Of the Basin's 136 districts, 85 districts, or 62 per cent, now have highway connections. Most important of all, the various projects for canalization of the numerous streams in the Basin have been vigorously advanced. Many of these projects (such as the Chi and Upper Chialing rivers) have already been completed. These achievements and many more to follow will make a long stride toward the satisfactory solution of the Basin's acute transportation problem.

As to the future development of the Basin, one may approach the problem from two standpoints: first, the future prospect of the Basin as a base of operation against the Japanese invasion; and second, the future position of the Basin when peace returns once more.

As regards the first objective, the future of the Basin is bright. First of all, here, in Szechuan Basin, one finds a unique geographic region which has the interesting and fortunate combination of a mild south-China climate (with a long growing season), a rich north-China mineral resource (particularly coal and iron), a Yangtse Delta agricultural wealth, and above all, a southwest-China rugged mountain topography which provides protection against military invasion. The agricultural richness of the Basin is particularly important in maintaining a sustained self-sufficiency and should enable the region to hold longer against invading forces than would otherwise be possible.

Furthermore, the high strategic quality of the Basin's geographic position and its rugged topography have strengthened the Basin's capacity to serve as a citadel against military encroachment from outside. By virtue of its inland position, over 1,500 miles away from the coast, the Basin is reasonably protected from an enemy's navy attack, against which the rest of China is now almost completely helpless. Moreover, the Basin's rugged terrain and surrounding mountain ranges make land attack, even by modern mechanized forces, extremely difficult. Above all, thanks to the prevailing cloudiness in the Basin during most of the year, and to the presence of numerous rocky hillsides which can readily provide air-shelters, even modern air attacks have been reduced in intensity and effectiveness.

Taking all the above factors into consideration, Szechuan Basin is geographically better qualified than any other part of China to serve as a base for carrying on China's war of emancipation against barbaric invasion. It has served this purpose successfully many times during the historical past. No doubt, it will assume this important responsibility again. Being now better equipped and better prepared, the Basin will probably give an even more satisfactory account of itself this time. Time and space, history and geography, the two best friends of China, have always been at her side and have never failed her so far throughout her long existence as a great civilized nation. Undoubtedly, they will be with her this time. The Basin will again do its share to substantiate this truth.

As regards the second objective, the peace time future of the Basin is equally promising. With the diverse agricultural products, abundant forestry resources, and other assets, it should be sound national policy and good geographic division of labor to develop the Basin as a self-sufficient and well-endowed region in the vast space of China's interior. The development of the Basin will not only help to secure a more sound and well-balanced national economy in peace time, but also will provide a better preparation for national emergencies which may take place at any moment in this disturbing world. Such a development has been made particularly imperative in view of the recent opening-up of southwest China to the western world by way of the Indian Ocean. For the first time in her history, China has thus been brought into direct contact (by modern transportation) with the western world

through her back-door. It is probable that much if not most of the heavy flow of international trade will be diverted from the traditional Yangtse Gorge route to this back-door route through the Basin in the near future.¹

Thus, whether in time of war or in time of peace, Szechuan Basin will be the natural center of activity among all the southwest provinces of China. It is indeed no exaggeration to say that both geographically and economically there is no other geographic region in all China than Szechuan Basin which is better qualified to play a vital role in carrying on the war against the invaders and in furthering the emergence of a New China.

¹The recent temporary successes of the Japanese along the southwest Pacific may delay this eventuality somewhat but will not alter the inevitable course of the region's future development. Geographers, being space-minded, should, at no time, lose the perspective of time.

CHAPTER II

FUNDAMENTAL PATTERNS OF SZECHUAN BASIN

Szechuan Basin, or Red Basin,¹ as it is commonly known to the western world, is located in southwest China (Fig. 1). It is one of the richest and the most distinctive geographic regions of China. Politically, Szechuan Basin belongs to the province of Szechuan. The word, Szechuan, meaning "four streams," refers to the four main tributaries of the Yangtse, namely, the Min, the To,

¹F. von Richtofen (*Ergebnisse Eigener Reisen* [China, 1912], III, 180) was the first western geographer to use this German name, "Das Rothes Becken," for this region. This was translated as "Red Basin" in English, and it has since become the official name for this region in all western geographical literature. It is a well-known fact that F. von Richtofen's original christening of this area was based primarily on the coloring of the dominant geological formations of cretaceous sandstones and shales. But, during recent years, upon closer examination and more careful study of the region, many students have expressed doubt as to the appropriateness of the name "Red Basin" for this region. First of all, from the standpoint of coloring of the geological formations, not all of them are "red" (cf. C. Y. Lee, "Development of the Upper Yangtse Valley," *Bulletin Geol. Soc. of China*, XIII, 107-17). As a matter of fact, the formations (sandstones and shales) range in color from grey, brown, yellow, buff red, and purple, to deep chocolate. Some observers even insist that in so far as the color of the soil (which is one of the important factors in agricultural land-use) is concerned, it is perhaps more appropriate to call this region the "Purple Basin" (cf. J. Thorp, *Soil Geography of China* [1936], p. 200). At least, it seems fair to say that this "Red Basin" is, after all, not all "red."

Secondly, from the standpoint of soil classification and soil coloring, the term "Red Basin" is particularly misleading and inappropriate. As Thorp has emphatically and rightly pointed out, the use of this term would tend to confuse the rich and fertile "red" soils of the Basin with those highly leached, infertile red soils of other parts of southwest China. In any case, in spite of the popularity it has long enjoyed in geographical literature, the name "Red Basin" seems to be obsolete and is no longer scientifically correct. Instead, the writer proposes to adopt the name "Szechuan Basin" (both Buck and Thorp have also used this name in their recent publications). This name not only does away with all the misunderstandings, as already pointed out, but also conveys, as we shall see later, the political provincial name and the prominent physiographic feature of the region, for "Szechuan" literally means "four streams."

the Fou, and the Chialing,¹ which flow from north to south through the province.

The term, Szechuan "Basin," as used in the present study, is not identical with the political unit of Szechuan "province." Moreover, it slightly differs from the area known as the "Red Basin" in western geographic literature. The latter is slightly larger and includes a small portion of Kwei-chow province to the south.

As a matter of fact the boundary lines of "Szechuan Basin" as defined in the present study are topographic in character. After careful consideration of both physical and cultural patterns the 700-meter contour line (as the upper limit) was chosen as the line of demarcation.² In the actual drawing of the boundary line, however, some minor alterations have been made. For instance, where the selected contour crosses some of the minor narrow river valleys (such as the Chien and others), the boundary line is drawn at the middle-point of such valley rather than at the headwaters of the streams. Primarily this is done to exclude the extremely narrow strips of land in the headwater areas--lands in most places too steep for agricultural use. The total area of the Basin, thus delimited, is 146,842 square kilometers.³ This figure is

¹Most writers give widely divergent names to the four main tributaries of the Yangtse from which the province, as well as the Basin, derives its name. Unfortunately, many of these names are inappropriate. Personally, the writer believes the four most important tributaries of the Yangtse (for reasons which will be explained in the later paragraphs) should be called the Min, the To, the Fou, and the Chialing rivers (cf. A. Hosie, Szechuan, Its Products, etc., p. 17; G. B. Cressey, China's Geographical Foundations, p. 312; L. D. Stamp, Asia [1935 ed.], p. 523; C. Y. Chang, Geography of China, II, 79; and W. D. Geil, Eighteen Capitals of China, p. 293.

²Arbitrary as this criterion may appear to be at first thought, it has, however, at least three distinctive merits. First, within the boundary of this chosen contour line, as we shall see later, there is a maximum coincidence between the physical and cultural patterns. Second, within this boundary there lies the most habitable and the most prosperous areas of the whole province; this is geographically significant and is particularly important from the standpoint of the study of agricultural land use. Third, this contour line, unlike many other boundaries commonly drawn to delimit the Basin, has the virtue of being a quantitative line. It furnishes a more concrete, if not a more accurate, basis for drawing the boundaries. So far as the writer is aware, no one has ever used a completely quantitative line to demarcate the boundaries of the Basin.

³Average of four planimeter readings.

much smaller than the total assigned to the Basin by other investigators who use different criteria for its delimitation.¹

The Basin, thus delimited (Fig. 2), in its rough outline, is much like a trapezoid. The four angles of the trapezoid are marked approximately by the four well-known districts, namely, Kuang-yuan in the north, Ya-an² in the west, Sui-yung in the south, and Feng-chieh in the east (Fig. 2). The use of these four districts as the principal corner-posts of the Basin is not only topographically sound (i.e., they all lie within the limit of the same 700-meter contour line) but geographically accurate. For instance, northern Kuang-yuan marks approximately the northern limit of bamboo growths in the Basin.³ Structurally, Feng-chieh, being at the head of the famous Yangtse gorges, marks approximately the eastern limit of the cretaceous formations in this part of China. Ya-an, strictly speaking, lies at a transitional zone between Chinese and Tibetan cultures; whereas Sui-yung is situated at a crossroad between the fertile Basin to the north and the desolate mountain areas of Kweichow to the south (Fig. 2).

The total population of Szechuan is estimated as between fifty million⁴ and seventy million⁵ persons. Since there is no official census, most students are rightly skeptical about the accuracy of these estimates. In 1937 the Bureau of Civilian Affairs of the Szechuan Provincial Government first undertook a fairly thorough survey of the total population of the province. According to this report (Population by Hsien, Appendix I, Table 1), the total population of the province is 48,436,624 persons.⁶

¹Cf. Cressey, op. cit., p. 312; J. L. Buck, Land Utilization in China (1937), p. 79; Nai Tsiang Jen, Journal of China's Geographical Society, III, No. 4 (December, 1936), 727.

²This district, together with the other thirteen districts of southwest Szechuan, is now, by order of the National Government, incorporated into the province of Sikang (Report of Szechuan Provincial Government [1940], p. 3).

³See Figure 8.

⁴Report of the Imperial Ministry of Interior (1898).

⁵Later in 1916, since the Republic, the report of the Ministry of Interior and the estimates of the Post Office both affirmed this number of seventy million persons (Report of the Viceroy of Szechuan [1910]).

⁶Bureau of Civilian Affairs, Szechuan Provincial Government, Population Statistics (1937).

The total number of people in the province at the present time is estimated at about fifty-six million persons. This means an increase of seven or eight million inhabitants during the past few years as a result of the mass migration from the lower Yangtse Valley.¹ As the total land area of the province is 360,159 square kilometer² (excluding areas for districts recently incorporated under Sikang jurisdiction), this gives an average population density for the province as a whole of 135 persons per square kilometer. For the Basin proper, as delimited in the present study, the total population is approximately 43,000,000 persons.³ Thus in the same manner, the average population density for the Basin proper is 285 persons per square kilometer.

The Szechuan Basin with its present population constitutes a miniature melting-pot within the great melting-pot of China. The influx of the new and many heterogeneous groups of immigrants into the Basin (especially since the famous massacre of the Chang Hsien Chung of late Ming dynasty) brought with it many new ideas and new techniques, particularly in connection with agricultural practices. This later fact helps to account, as we shall see later, for the present heterogeneity of its agricultural landscape.

A. Major Natural Elements of the Basin

1. Surface Configuration

The Szechuan Basin is a great synclinal depression surrounded by moderate to high mountains. The "basin" character of this area is demonstrated graphically by two cross-section profiles, one drawn along the line 30.30 N. parallel (Fig. 3) and the other along the 106 E. Meridian (Fig. 4). As these profiles show, the land slopes toward the center of the Basin from all directions. This is particularly conspicuous from north and northwest to south and southeast, as is further evidenced by the direction of the northwest-southeast flow of the main tributaries of the Yangtse (Fig. 5).

¹Report of Chungking Municipality (1940).

²Szechuan Provincial Government, Report of the Bureau of Military Survey (1939).

³This figure is arrived at by the writer by subtracting population of all Hsien (counties) lying outside of the boundaries of the Basin as delimited in the present study.

FIGURE 3
PROFILE OF SZECHUAN BASIN
SECTION AT 30°30' DEGREES
NORTH LATITUDE



FIGURE 4

PROFILE OF SZECHUAN BASIN

SECTION AT 106 DEGREES EAST LONGITUDE

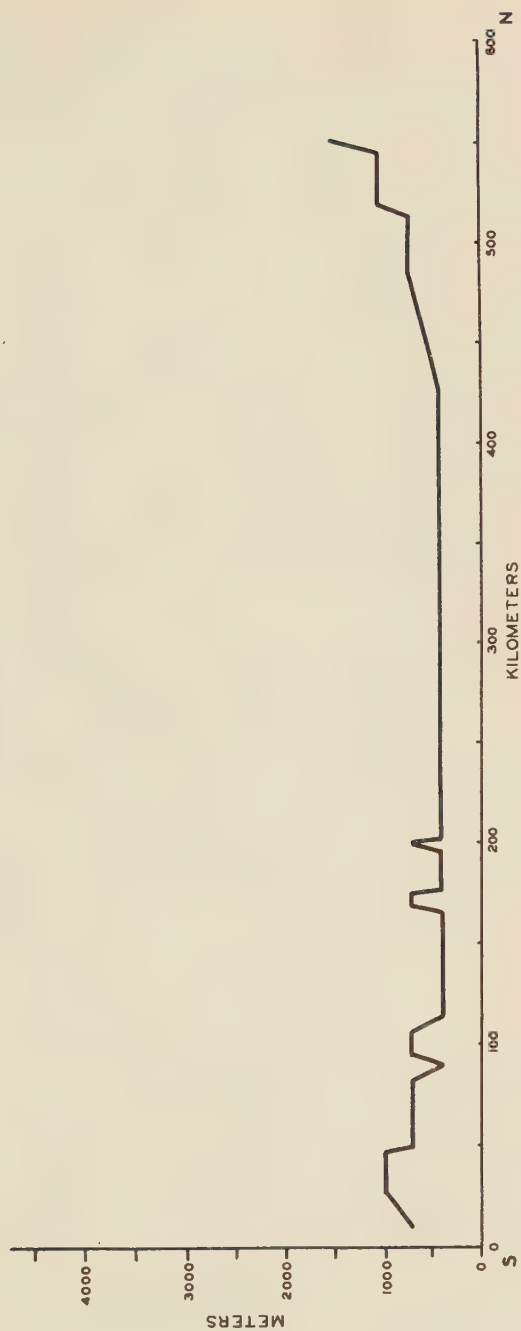
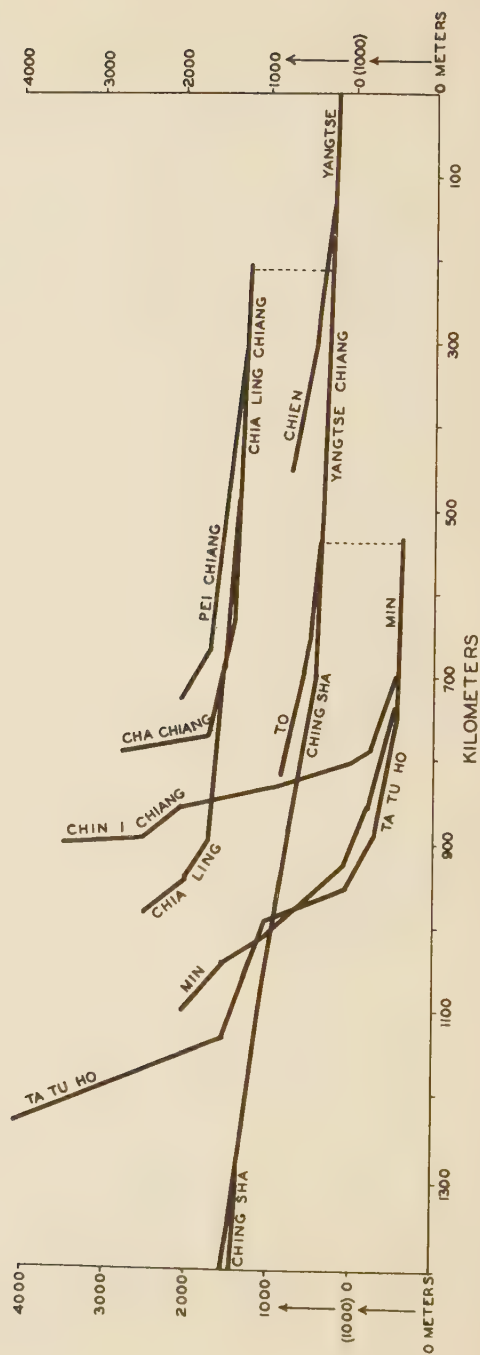


FIGURE 5

PROFILES OF PRINCIPAL STREAMS

SZECHUAN BASIN



The surface configuration of the Basin is dominated by numerous rolling, dome-shaped or flat-topped (mesa-like) hills (Fig. 6) of various magnitudes. They look much like graves--only on a larger scale--and are formed mainly by beds of cretaceous sandstone and shale. These hills are, in general, not over 100 meters in height, but in most instances, the lower ones are less than 50 meters high. Commonly they are isolated from each other and do not form any regular system or pattern. The local relief between these hills varies from locality to locality, and differs according to the relative magnitudes of the hills themselves.¹

Another striking topographic feature of the Basin is the presence of a number of anticlinal ridges, which are formed by the resistant limestones and sandstones of the Triassic, Jurassic, and even Permian periods. Most of these anticlines possess an axial trend of a northeast-southwest direction, being in most cases parallel to the bases of the trapezoid (Fig. 2). Many of them are open and symmetrical anticlines of considerable linear extension.²

Aside from some narrow strips of valley bottom lands found in the To, the Chialing, and the Fou river valleys, the most impressive scene in the Basin's surface configuration is the famous rich Chengtu Plain (Fig. 2), the only large continuous tract of flattish land in the whole Basin. This plain offers a striking contrast to the hilly or mountainous configuration of the rest of the Basin. It is a bona fide clear-cut geographic sub-unit within the Basin. It possesses a distinct geographic personality of its own and represents one of the most prosperous agricultural regions of the whole Basin.

2. Drainage Patterns

From the air, the principal drainage pattern of the Basin looks roughly like a netted-veined leaf with the Yangtse conspicuous as its midrib, and the main tributaries, both north and south,

¹Unfortunately, on a map drawn at the present scale shown here (1:2,000,000) and with the large contour intervals (200-1,500 meters), this local relief cannot be clearly visualized. The map (Fig. 2) does show, however, that the south central areas are of lower elevation, and have more continuous flattish surface than those to the north of the Basin.

²Y. T. Chao and T. K. Huang, Geol. of the Tsinling Shan and Szechuan (Geol. Survey, China; Memoirs Ser. A., No. 9, 1931), p. 39.

as its branch veins. The distribution of these veins seems, however, to be somewhat unilateral with the heavier concentration of streams in the upper, or northern, half of the leaf (Fig. 7).

The drainage pattern of the Basin possesses some distinctive and readily observable characteristics. One is the close relationship between the direction of flow of the streams and the local geological structures. First of all, most of the streams (particularly those in the areas with the folded structure) flow either at the bottom of a syncline or on top of an anticline, especially if the latter happens to be composed of less resistant formations than those which are present in the surrounding area.¹ Second, when a river transverses the longitudinal axis of resistant anticline ridges, in most cases at right angles, steep gorges are characteristic. This is particularly true in the case of the Yangtse and the Chialing rivers. Third, practically every river in the Basin has a number of terraces lying above the present level of high water. Each of these terraces probably represents a stage when river erosion was quiescent at the particular locality in which the terrace occurs. Rivers were rejuvenated after each of these stages of terrace development and their flood plains channeled to new depths. For instance, beginning from Feng-chieh, at the head of the gorges, following the Yangtse, extend a number of terraces of different magnitudes and heights, ranging from 15 to 50 meters. Particularly these terraces of the 50-meter-high are of great significance in the location of towns and villages.² The great city Chungking, as well as the urban centers of Feng-chieh and Yun-yang, for example, are located on these 50-meter-high river terraces. Cities of lesser magnitudes like Chung-hsien Pei-ling, and others are located on the 20-meter-high terraces.

3. Vegetation Forms

The Basin is well known for its rich plant life. Vegetation forms peculiar to all climates, ranging from tropical palms to sub-polar firs, flourish in close juxtaposition and in great profusion. Generally speaking, however, there are three major

¹Chao, op. cit., p. 26.

²W. H. Wong, "Notes on a Journey to Szechuan," Chinese Geographical Magazine, XIX, No. 4 (1931), 9.

areas of vegetation associations within the Basin¹ (Fig. 8). They are, first, the pine-cypress-banyan-bamboo association, occupying a large portion of the central and southern part of the Basin; second, the dense mixed coniferous-deciduous--mainly chestnuts (*Castanea*), oak (*Quercus*), and sweet gum (*Liquidambar*)--grassland associations, occupying the highland areas surrounding the Basin; and third, the coniferous (composed of mainly the Genera *Abies*, *Picea*, *Tsuga*, and *Larix*) grassland-Rhododendron associations, occupying a large part of the western Basin.

Particularly in the third of the areas mentioned in the preceding paragraph altitudinal zonation of vegetation is clearly shown.² As a rule the forests are on higher levels, whereas the intermediate slopes are covered with grass vegetation. Northwest of the Basin there lies the well-known "prairie" area, including both the tall bunch and short grasses (mostly stipa and some thick sods of *Avena* and *Festuca*) developed on the degenerated chernozem soils of the Sung-pan districts.

4. Soils

As soils will be discussed in more detail in connection with the agricultural land use, only the principal soil regions will be mentioned at this point. Generally speaking, there are three soil regions of major significance in the Basin³ (Fig. 9), namely, (1) the purple-brown (forest) soils, distributed in most parts of the Basin, (2) the non-calcareous alluvium and rice paddy soils mainly in Chengtu Plain and some other minor river valleys, and (3) the slightly to moderately podsolized old and young yellow earths found in the peripheral highland and anticlinal ridge areas of the Basin.

B. Major Elements in the Cultural Landscape of the Basin

1. Population Patterns

The most striking feature of the population pattern of the Szechuan Basin is that with the exception of the areas around

¹C. S. Fang, Personal correspondence, April 16, 1941.

²Ibid.

³J. Thorp, Soil Geography of China, Plate 1, 1936.

Chengtú Plain, the population density decreases from the interior of the Basin toward its fringes (Fig. 10). This generalization is more nearly true in the northern part than in the southern part of the Basin.

In most cases, the average population density of peripheral Hsiens, as previously mentioned, ranges between 11 and 50 persons per square kilometer. This density is much lower than that in the interior areas of the Basin (Fig. 10). Such a condition clearly demonstrates one very significant fact, that is, the close adjustment of population to relief in Szechuan Basin. As already pointed out, the general topography of the Basin tends to be more rugged as one moves from the interior of the Basin toward its periphery. A comparison of the Relief Map (Fig. 2) and the population density map (Fig. 10) emphasizes the remarkably high degree of coincidence between these two patterns. In other words, in areas where the surface configuration is more rugged (as in the fringing areas of the Basin) the population density is lower than in the more nearly level areas.

The actual population distribution and population densities of the Basin, owing to the great diversity of its topography, soil, climate, agricultural and other products are by no means uniform. Generally speaking, the Basin displays five densely populated areas, namely, the Chengtú Plain, the central and lower To River Valley, the south central industrial area, the central and lower Fou River Valley, and the discontinuous areas of Chusien-Chung-hsien-Changshou areas in the eastern Basin (Fig. 10). As we shall see subsequently these five densely populated areas correspond fairly closely with the five principal agricultural areas of the Basin.¹ The first two are the richest two agricultural regions of the Basin.

The Chengtú Plain--the first of the five densely peopled areas--with its flat topography, ever-renewed fertile soil, and excellent irrigation systems, is the most prosperous agricultural area, and has the highest population density within the Basin. The average density is more than 500 persons per square kilometer. In some districts the average density runs as high as 600 persons or more per kilometer. These include the districts of Pi-hsien, Hsing-fang, and Wenchiang, west of Chengtú (Fig. 10 and also Fig. 11 on index map of Hsien). Here, in addition to the rice culture

¹See Figure 24.

which is universal throughout the Chengtu Plain, the specialization and the extensive production of tobacco¹ (reputed to be the finest in China for cigar-making) has increased the returns from farming and made possible this unusually high population density. The only districts of the Plain, which have comparatively lower population densities (below 350 persons per square kilometer) are Tsung-ching and Kuan-hsien (Fig. 10). The explanation for this situation lies mainly in the fact that these two districts have higher local relief and are handicapped by insufficient water for irrigation. For instance, on account of the lack of irrigation, rice is not widely grown in Tsung-ching. But, on the whole, in so far as the population density and the capacity for agricultural production are concerned, Chengtu Plain compares favorably with the Delta area of the Yangtse.²

The rich horticultural and sugar cane producing area³ of the upper central To River Valley constitutes the second high population density area of the Basin (Fig. 10). Here, the average density is around 400 persons per square kilometer. With its comparatively flattish topography--probably the flattest next to Chengtu Plain--and its rich sugar cane production, the lower and central To Valley is agriculturally one of the most prosperous areas of the Basin.

The south central industrial area, including the districts of Fu-shun, Lung-chang, Yung-chang, and Pih-shan represents the third of the high-population-density areas (Fig. 10). Here lies the world-famous salt-brine mining district of the Basin. This is perhaps the only important industrial center of the whole Basin. It is reported that in Tze-kung area alone, there are more than 400,000 people, two-thirds of whom are said to be engaged in salt production and other manufacturing activities. In addition to salt, large quantities of coal are produced. The average population density in this area is well over 400 persons per square kilometer.

The central and lower Fou River Valley, including the districts of San-tai, Shei-hung, Sui-ning, Peng-hsi, and Nan-chung,

¹See Figure 37.

²P. M. Roxby, "The Distribution of Population in China," Geographical Review, XV, No. 1 (1925), 1-24 (Map).

³See also Figure 37.

noted for their specialization and rich production of the famous yellow silk and for cotton and herbs, is the fourth densely populated area. The average density in this area exceeds 350 persons per square kilometer. This area represents the richest agricultural part of the northern Basin.

The fifth area with a high density of population consists of a discontinuous tract of districts, including Chu-hsien, Chung-hsien, and Chang-shou north and east of Chung-king. These districts lie within the longitudinal anticline areas of the Basin, and in most places their topography is mountainous and rugged. The population density in this section of the Basin, as a whole, is low (Fig. 10). The exceptionally high population density of the discontinuous tracts mentioned above (with an average density of over 300 persons per square kilometer) probably is due to the rapidly increasing development of tung tree and coal productions during the recent years. This development has increased considerably the population-support capacity of these districts, as compared to the surrounding areas.

Outside of these five high population density areas, most of the districts of the Basin have a population density of about 250 to 350 persons per square kilometer. This approaches the average density (285 persons per square kilometer) for the Basin as a whole. In general, this average density is comparatively lower than the average density of the lower Yangtse Delta area, but is somewhat higher than the rural area of North China.¹

Although many agriculturalists² classify Szechuan Basin as a "rice region," actually, on account of its rugged topography and deficient water supply, only a part of the hilly areas are used for rice culture. These are the "ti-tien" or ladder lands (terraces). On the other hand, considerable portions of these lands are devoted to unirrigated or "dry" crops, such as corn, potatoes, kaoliang, wheat, barley, millet, and others. This fact explains perhaps why the Basin, as a whole, in so far as population density is concerned, lies at a midway position between the higher densities of the rice region of the Yangtse Delta and the lower densities of the wheat region of North China.

¹Hu, op. cit., p. 26.

²Buck, op. cit., p. 78.

2. Settlement Forms and House Types

Aside from large urban units (with population of 100,000 or over) which will be discussed later, the principal settlement forms of Szechuan Basin may be classified as follows, namely, the Hsien capitals, the villages (with aggregated hamlets), and the isolated farmsteads.

The Hsien capitals, corresponding somewhat to the County seats of the United States, often have a population of between 10,000 to 30,000 persons or more. Most of these Hsien capitals are the centers of activities of a Hsien (district). Some of them are situated along the river valleys, some on river terraces, and some at the saddle of two hills. The spacing of the Hsien capitals varies greatly in different sections of the Basin, depending upon the local topography, the rural economy, or other factors. As a rule, however, they are about 30 miles apart from one another.

Like other rural areas of China, the most common settlement form in Szechuan Basin is the village with clustered (aggregated) hamlets. But unlike many parts of rural China, Szechuan Basin contains comparatively few large villages of this type. In large measure this exceptional condition is related to the rugged and extremely dissected topography of the Basin. This is particularly so in the east and north of the Basin where hill country prevails. In the comparatively flatter and more heavily populated districts in the south central part of the Basin and in Chengtu Plain, however, large village settlements with aggregated hamlets are quite common.

The permanent population of a village settlement may vary from twenty or thirty to three or four hundred families, depending upon the location and prosperity of the district. It is rare, however, for a village to exceed seven or eight hundred families or a total population of three to four thousand persons.

In many cases the village settlements, if local topography permits, are rather closely spaced. In the most densely inhabited areas, they are at no point more than five miles away from one another. In the less densely settled areas, villages may be more than 15 miles apart.

The isolated farmstead is another common settlement form in the Szechuan Basin. These are of two sub-types: one localized in Chengtu Plain and the other distributed through the various

hilly parts of the Basin. In the former the farmsteads are more closely spaced than are the farmsteads of the hilly areas. Each of the sub-types is sharply different from the other in structures and in general appearance.

In Chengtu Plain, most isolated farmsteads have fairly well-spaced compounds. As a rule, the structures of these farmsteads have only one story. The walls are made of mud or plaster and the roofs are either thatched with straw or made of tiles. In most cases the layout of these buildings is either "U" or square in shape (Fig. 12). Commonly they include the living quarters, animal and poultry barn, grain and straw storage quarters, implement houses, and are surrounded by high white-washed walls. Most of the farm houses are well-shaded by trees, such as the cypress, the bamboo, and the nanmu and other fruit trees (Fig. 13).

In the more hilly sections of the Basin, particularly in its peripheral areas, isolated farms are found perched on the flat surface of hills. The spacing of these isolated farmsteads is by no means regular and it is everywhere in harmony with the rugged and dissected local topography. Most of the structures in these areas are shabby-looking, flimsy affairs, of very poor quality. In most cases they have mud or brushed walls. Corn-stalks are a common covering for the roof, since both straw and rice stalks are scarce in the hilly areas and have to be brought in from the plains.

In so far as the outward appearance is concerned, most of the houses in the Szechuan Basin are characterized by projecting eaves, gracefully recurved roofs, and rich, elaborate, and well-designed roof ornaments. It is interesting to note that these characteristics are made possible because of three favorable natural conditions in the Basin. First, there is little wind in the Basin and wind storms are practically unknown, thus the fragile and extraordinarily beautiful structures and decorations need little or no protection from wind. Second, there is practically no snow to weigh down and pry off a delicate projecting eave. Third, the fact that there are frequent misty rains in the Basin makes it necessary for practical purposes to project the roof eaves over the walls in order to provide protection from the rain.

3. The Village Fair--An Important Rural Institution of the Basin

The village fair is an important institution in the rural life of the Szechuan Basin. Such fairs, though quite common in many rural parts of China, are especially widespread and colorful in the Basin, and command great geographical interest. On account of the rugged and dissected topography, and consequently the detached character of the settlement forms in many parts of the Basin, there has been a greater and a more urgent need for some such institution than in much of China.

In many cases the village fair, locally known as "Chang" or enclosure, is the sole place where farmers living in isolated farmsteads and small detached settlements buy and sell their products. The village fair, therefore, is one of the most vital channels of rural economy in many parts of the Basin, particularly in the more hilly areas.

Ordinarily, the sites of the fairs are chosen on the more spacious and flat areas. On account of the scarcity of such areas in many parts of the Basin, however, most of the village fairs are rather limited in extent and consequently over-crowded. Normally they are either on the flat tops of moderate hills, or at the saddle or divide of two hills. In many cases they are held at places where temple grounds are available. The fairs are commonly spaced about 10 li (one li equals approximately a third of a mile) apart, and seldom are separated by more than 30 li. The spacing depends upon the local topography and the conditions of settlement. Because there is no means of transportation in many parts of the Basin, the ideal spacing is at a distance of less than twenty li, i.e., within walking distance of each other, so that the farmers in the areas between the fairs can make a round trip within one day. In most cases, as in the Chien Wei district of the western Basin, the interval between the village fair is about four or five miles, or a little over fifteen li¹ (Fig. 14).

The fairs are run on a definite schedule of dates, the frequency of which depends upon the volume of business the village commands. The usual schedules are 1-4-7, 2-5-8, or 3-6-9 days, alternating from place to place so as to suit the convenience of the inhabitants of the various areas nearby. The sequence and the

¹J. E. Spencer, "The Szechuan Village Fair," Econ. Geog., XVI, No. 1 (1940), 54.

FIGURE 14

DISTRIBUTION OF VILLAGE FAIRS
CHIEN WEI, SZECHUAN

0 4 8 MILES
0 10 15 KILOMETERS



LEGEND

- COUNTY BOUNDARY
-  RIVER
-  MOTOR ROAD
-  OLD MAIN ROAD
- VILLAGE HOLDING FAIRS
- VILLAGE NOT HOLDING FAIRS

C.Y.H.

Adapted from Spencer, J. E. Econ. Geog., Jan. 1940.

frequency of fair days is so adjusted as to reduce competition among the neighboring localities and to afford the greatest advantages to both buyers and sellers. The smooth operation of these schedules illustrates the type of local cooperation which is common in this part of China.

The typical village fair includes a grain merchant, a butcher, several tea houses, a few oil merchants, some firewood booths, vegetable booth, poultry stands, wandering native doctors, dentists, and fortune tellers. In spite of the extremely small area occupied by the fair grounds, it is interesting to note that a kind of system of automatic zoning has come into effect. For instance, it is almost a rule that the grain markets are located at the temple or other spacious grounds, whereas the tea houses, fortune tellers, and the wandering native doctors and dentists always occupy the center areas of the fair.

4. Farms and Field Patterns

One of the most striking features of the farms of the Basin is the predominance of terraced cultivated fields. Probably nowhere else in all China--with the possible exception of the loessial northwest--does one find the use of slope lands and the building of terraces so universal and so highly perfected as in the Szechuan Basin. Most of the low, round, amphitheater-like hills of the Basin are terraced and cultivated.

The terraced steps are of various widths. Each terrace rises above the preceding one (Fig. 15) and in many cases is faced by a wall of bare sandstones or shales. Each terrace is irrigated from the one below by a small stream of water regulated generally by some simple lifting device, such as a windless, driven by men or animal power. Generally speaking, most of these terraced fields are irregular, depending upon the specific land forms. In Chengtu Plain the fields tend to be rather square or oblong in shape, but most of them have irregular forms, owing to the need of fitting them into irrigation systems. In general, the units of the fields in Chengtu Plain, on account of its more continuous flat topography, are much larger than those in other parts of the Basin.

In the Basin, all land to be planted in rice, whether terraced or otherwise, is put, if possible, under water--generally a little over one foot deep--for the rice season. The field boundaries in most cases follow the natural elevations.

If one may admit color as one of the elements of the landscape of a region, one certainly cannot ignore it in the agricultural landscape of the Szechuan Basin. In fact the unusual combination of color in the agricultural areas adds much to the charm of the Basin. The bright red, purple, and chocolate-tints of the soil, the fresh-green of the grain crops, vegetables, and flowers, the brilliant yellow of the rape, the white-but-spattered-with-yellow-and-pink flowers of the tung trees, the snow-white color of the white-wax trees, and many other colors silhouetted against the ever-present dark-green background of the luxurious vegetation throughout the Basin, all add to its special picturesqueness.

The normal assortment of livestock life on the farms is a second noticeable feature of the rural scene in the Basin. Fowls, geese, ducks, pigs, bees are especially prevalent. Horses and mules are few. Oxen and water-buffalos are the most important animals on the farm. The buffalos particularly serve in various capacities, such as to plough and to burrow the rice fields, to mill the grains, to press the oils, and to perform a hundred and one other duties. Aside from human beings, they are really the other important "flesh-motors" of the Basin. On the farms, herds and herds of such bulky, slow-moving, long-horned buffalos may frequently be seen (Fig. 16).

Duck rearing is another activity of importance (Fig. 17), particularly in the Chengtu Plain. During the months of November and December one may see enormous flocks of ducks being driven slowly over the flooded paddy fields of Chengtu Plain. They feed on the aquatic life in the waters as they are driven along. In two or three months the flocks arrive at Chengtu, fat for market, and at no one's expense!

5. The Character and Distribution of Cities and Towns

One of the outstanding features of the urban settlements of the Basin is that most of the relatively important urban units of the Basin are situated on the terraces near the banks of the principal streams (Fig. 7). For instance, beginning from Feng-chieh up to I-ping, following the Yangtse Valley, one may count no less than fifteen of these urban units, including the most populous cities and trading towns of the Basin (Fig. 7). The

localization of cities in the valleys also holds true for nearly all the main tributaries of the Yangtse, such as the Chialing, the To, and the Min to the north, and the Chi-chiang and the Chien-chiang to the south. Particularly, wherever two major streams converge, a big urban conglomeration is always found. The most noticeable examples are Chungking at the confluence of the Yangtse and the Chialing; Lu-Hsien on the Yangtse and the To rivers; I-ping on the Yangtse and the Min; Lo-shan on the Tatu and the Min rivers; Pei-ling on the Yangtse and the Chien rivers; and Ho-chuan on the Chialing and the Fou-Chu rivers (Fig. 7).

It is almost a rule that most towns are situated on the small river terraces, whereas the big urban conglomerations are invariably localized on the broad and high water terraces or at a confluence of two big rivers. This situation is due mainly to the fact that in a region like Szechuan Basin, where water transportation is a vital factor, it is only natural that urban centers should occupy sites accessible to water transport. Even though many of the streams are not fully navigable at all times during the year, the river valleys offer the lines of least resistance and furnish the easiest means of access to the interior of the Basin.

The principal disadvantages of the urban settlements on river terraces are the limited areas of the sites, thus hindering an adequate development of the town patterns. Furthermore, with the great fluctuation of the high and low-water levels in most of the rivers of the Basin, as we shall see later, the hazards for flood are great. This latter fact has accounted for the presence of houses perched on awkward looking understructures of poles and posts. These difficulties are particularly apparent in the sections of the cities situated on the lower (20-meter-high) terraces of the rivers.

The spacing of the big urban units, generally not over 100 kilometers and often less, depends upon many conditions including the length of the navigability of the streams, the level of the terrace where they are situated, and the relative extent and prosperity of the hinterland of each of the urban units.

In their outer appearance, most of the urban units in the Basin are compactly built. In general, the houses have only one story. There are no yards or sidewalks in front of the houses and thus the houses abut the streets. The streets, in their turn,

are narrow, in most cases not over eight to ten feet wide, and are paved with limestone slabs. The arrangement of streets, as a rule, is in harmony with local topography and with the general pattern of the settlement in question.

Like many other long settled and unplanned urban communities in the Orient, most of the urban centers in the Basin have no sharp delineation in their functional areas. In fact, many of the functional areas are so juxtaposed and intermixed that it is almost impossible to describe them.

Taking Chengtu, for example, the city, in so far as division of functional areas is concerned, is so undifferentiated that nearly the whole city may be considered as predominantly residential in function. This may even be true in some of the so-called business streets, because there are always families living behind shops and stores on the business streets. The matter is further complicated by the fact that families behind these shops may also carry on some handicraft manufacturing activities. Thus, business, residential, and manufacturing functions are all present in one area. Nevertheless, in many cases, one type of establishment or operation unit (such as shops, factories, residences, etc.) is so conspicuous that "functional cores"¹ may be recognized with relative ease, even though the delimitation of the "boundaries" of these "functional cores" cannot be made sharply.

An impressive feature of the urban scene of the Basin is that every city has a city wall. Although many cities have recently torn down their walls as a symbol of modernization, many of them still keep this age-old feudalistic structure. The city walls, made of bricks, are in general about 45 feet high and 3 feet wide. Owing to the absence of tall buildings in most of the urban areas, the city wall affords an ideal panoramic view of the city.

6. Transportation Patterns of the Basin

a) The major water routes.--Water routes are by far the most important means of transportation in the Basin. There are, all told, large and small, navigable and otherwise, 270 streams

¹By "functional core" is here defined as a conspicuous clustering-together of a number of establishments or operation units which perform a specific or principal function in that area or locality.

in the Basin, with a total length of 22,000 li.¹ Among them, the mighty Yangtse is, of course, the most significant. The Yangtse River traverses the entire width of the Basin in a southwest to northeast direction. It is the spinal cord of the whole stream system.

In so far as its use for transportation in the Basin is concerned, the Yangtse may be divided into two sections, namely, the I-Chang--Chungking section and the Chungking--I-Ping section (Fig. 7). In the first section, between I-Chang in the east and Chungking in the west, with a total distance of 912 kilometers, boats of three-meter draught may navigate during the high-water season (between May and November). Boats of two-meter draught or less ply this section during the whole year. In the second section, between Chungking and I-ping, with a total distance of 463 kilometers, boats with two-meter draught or less can navigate during high water, while boats of shallower draught (one meter or less) may navigate the whole course during low water.² I-ping is, for all practical purposes, the western-most point of navigation on the Yangtse (Fig. 7), although steamboats have made trial voyages as far as Ping Shan, twenty-five miles to the west of I-ping. Up to now, no river steamer has come regularly to this head of navigation.

The Yangtse is, for all practical purposes, the only important highway and the sole exit for the tremendous flow of goods from the Basin to the outside world. If the Basin be thought of as a bottle, the gorges of the Yangtse are certainly its vital neck. It is almost unimaginable that the Basin could have ever functioned as a prosperous geographic region without this generous gift of nature.

Of course, with the increasing growths of railroads and air transports in the Basin, the dominant position of the Yangtse may be somewhat affected. It is, however, fairly safe to say that in spite of these developments, the river probably will continue to play its significant role in the Basin for a long time to come. This prediction is based on the relative cheapness (though slow and difficult) of the river transport, the bulky nature of the commodities (largely agricultural and forestry), and the great

¹Shen, op. cit., p. 11.

²Ibid., p. 37.

difficulties (due to the rugged topography) of building other means of transportation in the Basin.

The harnessing of this mighty, swift, and treacherous stream by men for their own benefit, however, has been by no means an easy task. It is certainly not a story without excitement. There are tremendous difficulties involved in negotiating the world-famous Yangtse gorges, the numerous shoals, the whirlpools, and the rapids at intervals along the course of this mighty waterway. For centuries, the Chinese, with their slow-moving but colorful junks, have battled patiently and painstakingly with the perilous river. It was not until 1898, after experimenting for nearly two decades, led by a brave Englishman, Captain A. Little and later followed by the tireless effort of many energetic Chinese leaders in the Basin, that the first modern steamboat successfully passed through the gorges and arrived at Chungking.¹ Three years later, in 1901, a trial voyage farthest west to Sui-fu (I-Ping) was successful.

It was not until 1909, ten years after the first trial voyage, that suitable, shallow, and specially-designed vessels with a sufficiently large carrying capacity were put into use and regular steam navigation on the upper Yangtse became commercially possible. Since then, the development has been phenomenal. In 1919 there were only about 220 steamers of all tonnage-classes, totalling 55,000 odd tons, plying the upper Yangtse between the I-Chang and I-Ping section. But by 1936 the number of steamers totalled 2,140, with a total tonnage of 760,000 tons.²

The growth of steam navigation on the Yangtse resulted in the rapid and almost complete disappearance of the old colorful Chinese junks on the upper Yangtse. In 1894, a peak year in junk traffic, there were altogether 2,900 junks, with a total tonnage of over 100,000 tons. By 1925, thirty years later, only one junk, with a tonnage of 20 tons, was reported in the river traffic of the upper Yangtse.

Of all the navigable tributaries of the Yangtse, the Chialing River system is by far the most important. At Chungking the Yangtse is joined on its left bank by this important tributary, the so-called "little river." This is made up of three streams

¹L. C. Cheng, "The Waterways in Szechuan," Journal of Geog. Society of China, VI (1939), 7.

²Shen, op. cit., p. 38.

which unite at Ho-Chuan (Fig. 7). The Chialing River and its tributaries drain a fan-shaped area with an extent of a little over 160,000 square kilometers, or about a third of the total area of the province.¹ Aside from the Yangtse, the Chialing system is one of the most vital arteries of transportation in the Basin. Agriculturally, this area is not so prosperous as that of the Chengtu Plain or the To River area. Its average population density is likewise not so dense as those of the later two areas (Fig. 10), but, nevertheless, this area is rich in the production of herbs, tung tree and other forestry products, all of which are moved to markets by river transportation.

The importance of the Chialing drainage system is due to its navigability for long distances. The eastern-most branch, the Chu River (Fig. 7), is navigable, for small craft, up to some 40 miles north of Tung-hsiang-hsien. The central branch, the Chialing itself, is navigable, for fairly large boats, to Kuang-yuan, extending far into southern Kansu. Ships laden with herbs and other agricultural products descend to Kuang Yuan from Pikou in the province of Kansu. The western-most branch, the Fou River, is navigable up to Chung-pa, and one of its western tributaries taps the northeastern corner of Chengtu Plain (Fig. 7). The Chialing system is thus the greatest collecting and distributing center of the agricultural and forestry products in the Basin.

The Min River is noted not only for supplying water to the famous irrigation system of Chengtu Plain but also for its great significance for transportation purposes. In so far as navigation is concerned, the Min River may be divided into three parts (Fig. 7). The section between Kuan-hsien and Chengtu is navigable to small flat-bottomed junks all year round (Fig. 7). The section between Chengtu and Lo-shan is navigable to boats with a capacity of 50 to 60 tons all year round; recently the trial voyage by the Ming Seng Company, with steamers of 200 tons and in less than one-foot draught, has been successful. It is announced that this route will be opened as a regular commercial route in the very near future. Finally, the section between Lo-shan and I-ping, a distance of 160 kilometer, may be negotiated during the high-water season (June to November) by steamers with one-to two-feet draught.²

¹Cheng, op. cit., p. 29.

²Shen, op. cit., p. 56.

Here, in the Min River drainage area, one finds a region of the richest agricultural production (with the highest cultivation-land index) and has the highest population density of the whole Basin (Figs. 21 and 10).

Among all the main tributaries of the Yangtse, the To River possesses the richest hinterland and has the most diverse agricultural and horticultural products. The To River, formerly known as the twin river of the Min, is composed of two branches: one is the Mien Yang Ho, originating in the Chiu Ting mountains, and the other, the Pai Tiao and Pu Yang rivers, tributaries of the Min. Both of these branches meet at Chao Chia Tu (Fig. 7) where, for all practical purposes, is situated the head of navigation of the whole To system. From Chao Chia Tu to Lu Hsien, the confluence of the To and the Yangtse, with a total of a little over 280 kilometers, junks with 50 to 60 tons capacity may ply all the year round. Between Lu-hsien and Fu-shun, steamers with one-to two-feet draught may negotiate during high water.

b) Highway patterns.--Next to the waterways, the highways furnish the most important channels of transportation in the Basin. The era of modern highway building in the Basin was first initiated in 1925, when a group of European-trained young Szechuanese engineers returned home and advised strongly the undertaking of such a program. The first highway completed was between Chengtu and Kuan-hsien (Fig. 7). But it was not until 1935, after the political unification of the Basin and the establishment of the provincial Bureau of Highway Construction, that the highway building program was carefully launched and systematically coordinated.

On account of the thoroughly dissected topography and the presence of numerous anticlinal ridges, together with the easily weathered rock structures, the building of highways in the Basin is not without serious difficulties. The constant threat of landslides, the presence of numerous steep slope and hairpin turns, and the necessity of building many solid embankments, make the building and maintenance of highways in the Basin both costly and hazardous.

At the end of 1940, more than 6,400 kilometers of highways were completed within the Basin. In fact of the province's 136 districts, 85 districts, or 62 per cent, now have highway connections. These include six trunk inter-provincial lines and a number

of other important lines within the Basin (Fig. 7). Four more trunk lines are still under construction.¹

The highway system of the Basin was laid out with Chengtu as its center. The six trunk inter-provincial lines, most of them radiating from Chengtu, include the Szechuan-Shensi, Szechuan-Kweichou, Szechuan-Hunan, Szechuan-Hupeh, Szechuan-Sikang, and Szechuan-Yunnan lines (Fig. 7).

Among the inter-provincial trunk highways, the Szechuan-Kweichou line is at present the most significant. This is mainly because of the fact that the northern section of this highway, from Chengtu to Chungking (with a distance of 450 kilometers), also forms a part of the Chengtu-Chungking highway. Thus it is also one of the principal arteries of transportation within the Basin. Moreover, it is through this vital channel (the Szechuan-Kweichou highway) that the urgently needed war materials from abroad, and the flow of Szechuan agricultural and forestry products, such as silk, tung oil, and others, for exports to the western world, are now transported (Fig. 18). This route now plays exactly the same vital role as the Yangtse gorges route did in the pre-war days. Its importance, indeed, cannot be over-exaggerated, so long as the present war against the invaders continues.

Other important highway lines within the Basin include Nei-chiang-Tzeliuching, the Chengtu-Kuan-hsien, the Chung-Pa-Pishan, and the Santai-Mienyang lines (Fig. 7). The last line is particularly important because it forms part of a through route running north and south within the Basin.

c) The principal rail-line.--In all of Szechuan Basin there is only one "toy" railway, 120 li long (Fig. 19), running between Hsi-shan and Pai-miao-tze. It was constructed with 20-pound rails and a 24-inch gauge.² This line, known as the Pai-chuan Railway (Fig. 7), was erected in 1929. Its chief function is to facilitate carrying coal from Lung Wang Tung and Pai-Chuan mines to the nearby urban markets of Chungking. Up to now no railway of any significance has penetrated the Basin.

¹Bureau of Reconstruction, Szechuan Provincial Government, Highway Statistics (1940), p. 46.

²H. R. Issac, "The Only Railway in Szechuan," Far Eastern Review, XXVII, No. 9 (1931), 551-54.

The need for railroads in the Basin is most urgent and the clamor for railroad construction is loud. Already there are four projected railroads, namely, the Chengtu-Chungking, the Tzeliuching-Luhsien, the Chengtu-Paochi, and the Chengtu-Kuming lines (Fig. 7). The Chengtu-Chungking projected line is already under construction. This line, after its completion, will link the rich agricultural Chengtu Plain and the growing industrial Chungking area. Furthermore, the completion of the Tzeliuching-Luhsien line will bring forth a more efficient operation of the vital brine-salt industry of the Basin.

d) The major air-routes.--If highway development in Szechuan Basin is still in its childhood, airway development is in its infancy. It was not until 1932, only about ten short years ago, at the initiation of the Shanghai-Chengtu air-line, that the Basin first experienced commercial air service. Since then, commercial flying in the Basin has been growing steadily. The original Shanghai-Chengtu Line has suspended operation since 1938 on account of the war.

There are now five principal air lines in the Basin, namely, the Chungking-Hongkong (now extended only to Kunming after the Japanese occupation of Hongkong in December, 1941), Chengtu-Sian, Chengtu-Kunming, Chungking-Chengtu, and Chungking-Loshan lines. Among them, the Chungking-Hongkong (now to Kunming) and Chengtu-Sian lines are the most important.¹

All the above air-lines are engaged principally in passenger and mail service. Freight capacity is still very limited. In so far as use for cargo transportation is concerned, the present air-line facilities are far from satisfactory. The airways of Szechuan are at best only a symbol of modernization, but the growth has been phenomenal and the future outlook is promising. The cultural and educational value of the air traffic to the inhabitants of the Basin is certainly tremendous.

e) The relation of transportation to the agricultural land-use in the Basin.--Among all the regional problems of Szechuan Basin, none is more important and more acute than that of transportation. The poor transportation has hampered in more than one way the efficiency of the Basin's agricultural and forestry land-use.

In the first place, the difficult and therefore costly transportation has prevented farmers in the Basin from earning as

¹Report of the Bureau of Reconstruction, Szechuan, op. cit., p. 52.

much from their crops as otherwise they might have realized. The classical example is that of wheat during the world war I, when wheat was in great demand throughout the world at that time and was sold for 2.50 to 3.00 Yuan¹ per bushel in Shanghai. At Chungking, however, only 1,500 miles away from the latter port, a bushel of wheat was sold for only ten cents! There is an old saying in the rural areas here: "Pai li pu fang tsu," literally meaning "bulk (grain) is not sold one hundred li away." This reflects vividly the difficulty and high cost of transportation.

Another astounding example is that many orange growers in the To Valley often let their oranges rot in the field rather than pick them, because it is so difficult and so expensive to get them to market. On the other hand, only 800 miles away, at Hankow, imported oranges are sold for about a dollar (Yuan) for a half dozen.

Finally, also due to the same difficult transportation, it is tragic to see many farmers in the more remote hilly areas let their land lie idle for months on account of the high transportation cost of shipping bulky fertilizers, such as soy bean or tung oil cakes.

7. Mining and Manufacturing Patterns

Approximately less than 10 per cent of the population in the Szechuan Basin are engaged in the mining and manufacturing activities. The Basin's recent rapid development in mining and manufacturing has strengthened its position as a rich self-sufficient geographic region. In fact, mining and manufacturing largely supplement the agricultural and forestry pursuits, and thus, as we shall see later, help to bring forth an increasing efficient agricultural and forestry land-use in the Basin.

With the numerous metamorphic formations, volcanic intrusions, and the Jurassic-Triassic (coal and salt-brine bearing here) formations, particularly in the fringing and the anticlinal regions, the Basin's mineral deposits are abundant and varied. They include both metallic and non-metallic deposits, such as iron, copper, gold, silver, aluminum, salt, coal, petroleum, and asbestos. Among them, judging from the volume of present production, salt, coal, and iron are by far the most important. The

¹One Yuan (dollar) in normal times (pre-war) has an exchange rate of approximately one-third of a United States dollar.

Basin produces annually about 4,000,000 tons of coal, 200,000 tons of iron, and 100,000 ounces of placer gold.¹

The production of brine-salt is the most important mining activity of the Basin. Brine salt is almost synonymous with Szechuan Basin in China. The Basin is the only region in all China to produce this commodity. Normally, the annual output of pure salt in the Basin is about 8,000,000 piculs (one picul equals 133 lbs.), with a total value between 30 to 35 million dollars (Yuan).

The salt-brine belt consists of a tract somewhat rectangular in shape, extending from the northern limit of the Basin adjoining Shensi to the Yangtse River at Lu-hsien on the east and to the Min River at Chien-wei on the west. Generally speaking, this belt lies north of the Yangtse and west of the Chialing River. But scattered brine fields are also found as far as the Feng-chieh districts, almost at the eastern-most edge of the Basin. The most important producing areas of brine-salt are, however, confined to the south central part of the Basin, particularly in the area between the lower Min and To rivers. Among all the producing areas, the Tze-Kung is the most noted (Fig. 20).

The Basin's manufacturing development has been greatly benefited by the presence of numerous agricultural and forestry products, such as silk, cotton, hemp, sugar cane, tung tree, wood pulp, and others. Long before the introduction of modern manufacturing, handicrafts of various kinds, relying principally upon the local raw materials, have been established in the Basin. At present, the most important manufacturing activities include cotton-weaving, silk-weaving, hemp-weaving, paper-making, glass-making, and tung-oil-refining.² The principal manufacturing centers of the Basin are located in the Tzeliuching, Chungking, and Lo-shan areas, where water transportation is most convenient.

¹Swen, op. cit., p. 42.

²W. H. Wong, "The Prospect and Economic Reconstruction of Szechuan," South West China Review, II, No. 3 (1940), 4.

CHAPTER III

AGRICULTURAL LAND-USE

Agriculture is the principal form of land-use of the Szechuan Basin. Among all the agricultural regions of China, the Basin is not only one of her richest regions but also, with its greatest diversity and widest range of agricultural products, the Basin represents almost a miniature China. Moreover, it is estimated that approximately 85 per cent of the people gainfully employed in the Basin are engaged either directly or indirectly in agricultural pursuits.¹ In the present treatment of the problem of agricultural land-use in the Szechuan Basin, major attention will be directed to the following points, namely, the land as chief natural resource of the Basin, distinctive features of its agricultural land-use, agricultural land-use in relation to natural elements of the Basin, the principal agricultural areas of the Basin, and the Basin's chief agricultural products.

A. Land: Chief Natural Resources of Szechuan Basin

1. Cultivation-Index and Areal Pattern Thereof

According to the latest report of the Bureau of Military Surveys of Szechuan Province, the total land area of the province is 360,159 square kilometers.² The area of the Basin as delimited in the present study is 146,842 square kilometers. The total area under cultivation, for the province as a whole--according to the report (1939) of the Bureau of Central Agricultural Research--is 103,632 square kilometers (Table 2); for the Basin proper (as delimited) it is 68,240 square kilometers. This means the province as a whole has a cultivation-index (ratio of cultivated land to

¹Bureau of Interior Affairs, Szechuan Provincial Government, Population Statistics (1937).

²Szechuan Provincial Government, Report of the Bureau of Military Surveys (1939).

total land area) of about 30 per cent, whereas the cultivation-index for the Basin proper runs slightly over 45 per cent. Considering its hilly and dissected topography, this cultivation-index figure for the Basin is fairly high, in fact it compares favorably with some of the flatter and more fertile areas in other parts of China.¹

The cultivation-index, however, varies greatly in different parts of the Basin. Some areas have an index much higher than 45 per cent, whereas other districts fall far short of it. The peripheral areas of the Basin have a rather low index, ranging between 11 and 20 per cent (Fig. 21). In Chengtu Plain the cultivation-index runs as high as 70 to 80 per cent. In some of the districts of the Plain, particularly in Pi-hsien, Hsin-ching, Wen Chiang, Shuan-liu, and Hua-yang in the southwestern part of the Plain, the figure is even higher than this. On the other hand, in many other districts, including Pei-chuan, Ping-wu, Miao-hsien, Cheng-ko, and Fu-hsi in the northern, northwestern, and northeastern fringes of the Basin, the cultivation-index runs as low as 3 to 5 per cent. Between these two extremes, most of the south central and eastern parts of the Basin have an index ranging between 30 and 50 per cent. Generally speaking, the cultivation-index of the south central districts is somewhat above the general average for the Basin as a whole, whereas the eastern districts fall short of it. The districts on the northern, northeastern, and eastern fringes of the Basin, such as Kuang-yuan, Nanchiang, Wan-yuan, Yun-yang, and Feng-chieh, which have an index of 15 to 20 per cent (Fig. 21), are far below the general average for the Basin as a whole.

These differences in the cultivation-index are clearly explainable if one bears in mind the layout of land forms of the Basin. As in the case of population pattern, the factor of topography plays a very important part. It is almost startling to note the high degree of coincidence which the three maps showing relief, population density, and cultivation-index (constructed from three different sources of data) bear to one another.

¹Buck's study reports that the cultivation-index for the Yangtse Rice-wheat area as a whole is 35 per cent, but for the Yangtse Delta alone, the figure is 100 per cent (*op. cit.*, p. 68). In the same study, Buck reports that the cultivation-index for the North-China Plain to be 68 per cent (*op. cit.*, p. 62).

2. Major Types of Land-Use

a) General statement.--Concerning the classification of main types of land-use in the Basin, there are no official statistics available. It is, however, estimated¹ that 32 per cent of the total land area is used for farming and its related purposes; 22 per cent for forests, brush, and other undergrowths, particularly bamboo; 3 per cent for graves and graveyards; 2 per cent for pasture; 2 per cent for grasses grown for fuel; 2 per cent for temple grounds; and 37 per cent for miscellaneous uses (including "huang-ti," wild lands or waste lands). These estimates, although no better than cautious guesses, do furnish a general picture as to land-uses and their relative significance.

To a western student of agriculture or geographer this relatively high percentage of total land used for graveyards and temple grounds, and this extremely low percentage in permanent pasture, may seem incomprehensible. Probably here lies one of the most fundamental differences not only between Chinese and western agricultural systems, but also between the two respective cultures. The high percentage of wild or waste land is also striking. This is partly a result of the rugged topography, limited water supply, and poor soil conditions in many sections of the Basin. It also is partly, perhaps mainly, a result of the incessant civil warfare which has prevailed in the Basin during the last twenty years. This misfortune has laid waste to thousands of acres of productive farm lands, and has rendered farm economy bankrupt.

b) Uses of crop land.--It is reported that the total land in crop in the year 1937, for the province as a whole, amounted to 108,174,564 mow (one mow equals one-sixth of an acre), of which 44,952,366 mow, or 43 per cent, were used for "shui-tien" (irrigated fields) or rice paddy fields, and 63,222,198 mow, or 57 per cent, for "hang-tien" (unirrigated fields) or dry-crop lands.² With the exception of Chengtu Plain and some other minor river valleys, such as the To and Fou, where a large portion of the crop lands are used for irrigated paddy fields, most of the districts of the Basin, particularly the hilly areas, are generally occupied

¹Bureau of Reconstruction, Szechuan Provincial Government, Land Statistics (1937), pp. 83-85.

²Bureau of Reconstruction, Agricultural Section, Szechuan Provincial Government, Crop-land Statistics (1937).

by "hang-ti" or unirrigated "dry" fields.

Dividing the total crop area by the total number of people in the province gives an average of about 2.5 mow of crop land per person. This is very small. It is also calculated that the average size of farm in Szechuan is about 16.3 mow,¹ which is slightly smaller than the average farm in north China (say, for Shantung province, 19 mow), but is much larger than the average size of farm in south or central China (say, for instance, Hunan province, 12 mow).² The size of the average agricultural land-holding reflects the medium position of the Szechuan Basin.

The most interesting thing about these farms in the Basin lies, however, not so much in their small size but rather in the manner and the intensity with which they are being used. According to Buck,³ 89.3 per cent of the total farm area in the "Szechuan Rice region" is used for crops; 4 per cent for farmsteads; 4.7 per cent for roads and graves; 0.7 per cent for wooded pastures; 0.7 per cent for forests; 0.4 per cent for pasture land; 0.1 for productive water area; and 0.1 for fuel grasses.

B. Distinctive Features of Agricultural Land-Use in Szechuan Basin

Nyhus, in his study of agricultural regions of China, classified Szechuan as the "west China" region.⁴ Buck grouped Szechuan as the "Szechuan Rice" area.⁵ Both of these classifications are widely known in the west and have often been quoted in western geographic literatures.⁶ However, both of them seem to neglect the most unique features of agricultural practice in the

¹Buck's finding for the "most usual size" of farm in the "Szechuan Rice region" is 2.4 acres, or approximately 14.4 mow, which is slightly lower than the figure arrived here (op. cit., p. 269).

²Bureau of Statistics, National Government, China, Agricultural Statistics (Nanking, 1933), p. 41.

³Buck, op. cit., p. 172.

⁴Paul O. Nyhus, Agricultural Regions of China (Bureau of Agricultural Economics, U.S.D.A., 1931) (maps).

⁵Buck, op. cit., p. 27 (map).

⁶G. B. Cressey, "The Agricultural Regions of Asia," Economic Geography, Vol. X (1934).

Basin. Particularly, Nyhus' classification of Szechuan as the "west China region," which includes large heterogeneous areas with diversified agricultural practice (for instance, Yunnan), fails to bring the agricultural land-use of the Basin into a sharp focus. Buck's treatment, in spite of the rich quantitative data he assembled, is handicapped by the lack of sufficient descriptive materials. Statistics alone, without comprehensive case descriptions, furnish only a dry skeleton which is of limited interest. In his contact with the agricultural practice in the Basin during the past years, the author feels there are a number of unique agricultural practices in the Basin which deserve special mention.

1. Extraordinary Diversity of Agricultural Products and Intensity of Land-Use

First of all, the agricultural system of Szechuan Basin is marked both by its extreme diversity of products and by the extraordinary intensity of its land-use. Although the Basin is generally noted and is commonly classified as a "rice region," (and rice is undoubtedly the predominant crop here), a more characteristic feature of its agriculture system is the production of many other unirrigated crops, particularly corn, potatoes, kaoliang, and millet. Nowhere in China, perhaps with the possible exception of Yunnan and Kwangtung provinces, have corn and potatoes become so significant in agricultural production as in the Basin. Moreover, nowhere else in China, perhaps beside the North China Plain and Manchuria, have kaoliang, millet, and soy beans been so widely cultivated as here. It is even more surprising to note that horticultural products so diverse as Lung yen (*Euphoria longana*), li chi (*Litchi chinensis*), sugar cane, and citrus fruits of tropical south China, and the best quality pears and persimmons of temperate cold north China are all found growing together here. Agriculturally and horticulturally, here in the Basin, one finds all of China represented in a miniature form.

2. The "Tung-Shui-Tien" System

Another characteristic agricultural practice here is the so-called "Tung-shui-tien" system, literally meaning "winter-storing-water field." In spite of the favorable climate and the fertile soil, and contrary to the popular belief of many western agriculturalists and geographers, large tracts of "ti-tien,"

terraced fields (estimated as high as 25 to 50 per cent of the total rice fields) are left fallow during the whole winter season. They are used for storage of water needed in the paddy fields the following spring. This peculiar situation is brought about by at least three factors: (a) Topographically, most of these "ti-tien," terraced fields, are of fairly high elevation, ranging from 50 to 100 meters or higher, and to secure water for irrigation is rather difficult. Thus it is found necessary to collect and store enough water at the lower terraces whenever possible during the winter for the spring crop. (b) On account of the mild climate of the Basin, and the lack of snowfall, the larvae of some harmful agricultural insects cannot be frozen to death. Storing water on the fields helps to kill off the insect pest for the spring crop season. (c) Because of the difficult transportation conditions and the prohibitive cost of transporting bulky fertilizers (consisting mainly of night soils and oil cakes) from one part to another within the Basin, and in order to conserve soil fertility and to safeguard a satisfactory summer crop, it is imperative to let these terraced hilly fields lie fallow during the winter season.¹

This unfortunate age-old practice of the Basin has hampered greatly the efficiency of its agricultural land-use. During recent years, many modern Chinese agriculturalists have seriously challenged the wisdom of this inefficient practice. Numerous suggestions have been made to correct it. One of the most interesting methods² recently devised is the construction of high retaining walls around these water-storing fields so as to increase their

¹Mr. E. F. Chen, of the College of Agriculture, University of Nanking (now at Chengtu), has recently conducted a series of experiments for testing the efficiency (in yields) of land-use on two sets of such terraced lands--one on which water was stored and which allowed to lie idle, while the other was cultivated. He found that fields in fallow gave a 69 per cent greater yield. This result, of course, seems to give an experimental justification for this peculiar practice. It is, however, only the result of a single experiment, and cannot be said to be the last word on this whole important problem. It is perhaps necessary to continue such experiments on various types of land with different physical qualities over a period of years before any significant conclusions can be drawn (cf. China's Soil Quarterly, I, No. 3 (1941), 33-38.

²L. F. Chao, "The Present Conditions and Future Programs of Agriculture and Forestry of Szechuan," Southwest China Review, III, No. 1 (1941), 17.

capacity to hold water. By so doing, considerable horizontal space (terraced fields) can be saved and made available for winter crops.

3. Rotation Systems and Inter-culture

Third, although inter-culture is an old favorite agricultural practice, universally adopted in all parts of China, nowhere does one find its practice so extensively carried out and so religiously followed by farmers as in this region. For instance, in cotton culture, the inter-planting with beans, corn, and other field crops, has been followed so extensively that it has almost ruined the cotton plant itself. Many agriculturalists have even cited this factor as one of the most important in the decline of cotton culture here. It is not unusual to observe, even on the tops of narrow dikes separating the rice fields, single rows of beans or other crops. Another common practice in inter-culture here is to plant beans, peas, or rape between rows of wheat.

4. Methods of Fertilization and Soil Culture

In most areas of the Basin, the purple-brown soil is only moderately fertile. In order to assure a good crop, fertilization is essentially necessary. There are a number of methods of soil fertilization practiced in the Basin. First of all, manuring is practiced at all times for all crops. Nothing is wasted which would tend to enrich the land. Sewage from cities and villages is carried long distances in buckets or in tubs to the fields, and nowhere else in the world is human excrement so highly valued and laboriously collected as is in the Basin. Besides, stable manure, potash-burned stubble, roots, weeds, rice husks, animal hairs, and anything that is otherwise valueless is collected and heaped together for purposes of fertilizing the soil.

The methods of fertilizer composting used here are different from those used in many other parts of China. The general procedure is to put all waste organic matters into a large heap, and to moisten the heap slightly to permit decomposition. Usually this slow decomposition takes months. But, recently, special yeast bacteria have been developed by the Bureau of Central Agricultural Research to hasten this process. Now it takes only three

weeks for decomposition.¹ By this method very little nitrogen is lost. The heap may be turned several times until the decomposition is complete and the fertilizer is ready for use in the field. Moreover, this process also increases the efficiency of the fertilizer in its usefulness to the plant.

Again, the manner of application of the fertilizer here is perhaps even more painstaking than the ways of preparation and composting. Sometimes a cupful of liquid manure or night soil is given to each plant at the period of its critical growth so as to secure the maximum efficiency.

The Basin also produces a number of oil-yielding plants and trees, such as rape, ground-nuts, beans, sesame, cotton, tung tree, and others, whose seeds and nuts, after the oil has been extracted, furnish refuse cakes of great value for soil fertilization purposes.

Another characteristic practice here is the widespread use of green-manuring by applying a special species of legume plant, locally known as "lu-tiao," (*astragalus sinenses*). This practice is particularly popular with farmers near the Chengtu Plain. According to the reports of recent experiments, conducted by the Central Agricultural Experimental Station, this plant yields the highest nitrogen content of any fertilizer. The government has been trying to encourage more farmers both in the southern and central part of the Basin to adopt this practice.

Second, soil culture has been widely practiced in the Basin. One practice is the so-called "Tiao-ho-po," which literally means "clean left-overs of the river banks." During the winter, in the low-water season, farmers living along the numerous small river valleys gouge the river bank and carry back to their fields in baskets the overflowing alluvial deposits. Due to the steep slope of many terraced fields and the high tilting of the rock structures, soil creep is very common. Thus a considerable portion of rich organic matter and surface soils from the hilly areas have been slipped down to lower land levels. It is a common scene to see farmers salvage these "fugitive soils" caught in pockets at the lower hillsides due to summer freshets or other erosional forces by carrying them back (during the summer season) in baskets to their upper hill fields. In many occasions one may find farmers

¹Ibid., p. 21.

actually paving the bare rocks with fresh soils they have secured from the river channels and trying to grow crops on them. This is bona fide soil culture. Consequently, the soil profile here is very confused so that any use of it as a criterion for soil classification is most difficult. In fact, in many places here, soils are almost completely lacking in any profile. It is certainly no exaggeration to say that considerable areas of soil here are, either directly or indirectly, humanly induced.

Moreover, on account of the shallowness of the soil and the soft friable character of the underlying cretaceous shales and sandstones, the farmers, in their everyday operations actually dig into the underlying rocks to hasten their weathering and decomposition so that more fresh soils can be "cultured."

5. Special Terracing Practices

Probably nowhere in China has a higher and more extensive utilization of slope land been made than in Szechuan Basin. Most of the hillsides are terraced into a series of gigantic steps. Many mountains have been terraced up to the summits. These terraces are commonly long narrow strips of land, and in many cases have rather steep slopes. Sometimes land with slopes as high as 60 degrees or more is terraced and used for cultivation. Intricate irrigation systems are established between these terraces. Whenever water is available, rice is cultivated in the fields. Praising these practices, one competent and sympathetic western observer once remarked:

These devices (terracing), combined with the untiring, patient industry of the people, have converted an incipient "bad land" into a rich and fertile region of terraced fields. In no part of China that I have visited are the people entitled to greater praise for their meritorious agricultural accomplishment than throughout this Red Basin.¹

However, on account of the steep slope of many of these terraced fields, as well as the failure to practice contour-planting, serious soil creep has been induced. This constitutes one of the most serious forms of soil erosion here.

¹Wilson, op. cit., I, 67.

C. Agricultural Land-Use in Relation to Natural Elements

1. Agricultural Land-Use and Climatic Conditions

Szechuan Basin has a unique climate. This climate is dictated more by its topography than by its latitudinal position.¹ To be specific, there are three chief factors affecting the climate: (1) the location in the interior of an extensive continent and a minimum of marine influence; (2) the surrounding high mountain ranges (these afford protection particularly against the strong Siberian and central Asiatic winds [by the Tsing-ling range to the north], as well as considerable protection against the monsoon [by the Taliang-shan and the Hsiao-Liang-shan to the south]); (3) the relatively high elevation above the sea (the average is about 1,250 feet and thus the Basin's summer climate is tempered considerably). The combined operation of these three factors has accounted for the exceptionally mild (for its latitude), cloudy, humid, and almost windless Szechuan climate. Especially the "Basin" character (surrounded by lofty ranges) of the Basin has cut down considerably the intensity of solar radiation and consequently the low evaporation rate. The two foregoing factors, in turn, cause the always cloudy skies and humid weather in the Basin.

The actual climatic conditions of the Szechuan Basin may be understood by separately considering "temperature," "rainfall," "evaporation and humidity."²

¹The Basin's northern-most boundary lies at latitude 32 N., corresponding to the latitude of Nanking; and its southern-most boundary lies at 26 N., corresponding to Foochow along the south China coast.

²The weather record throughout the Basin is rather a recent affair. With the exception of Chungking, which has a record of over forty years (kept by Customs) and Chengtu, which has a record of a little over ten years, most of the stations were established only during the last few years. In 1936, the Bureau of Reconstruction of the Szechuan Provincial Government established weather stations at Lo-shan, Nei-chiang, and Suining. Later, in 1937, more weather stations were established at Wan-hsien, I-ping, Ta-hsien, Yu-hsien, Lu-hsien, Ya-an, O-mei, and Sung-pang. The ultimate objective of this program is to establish, if possible, one weather station at each Hsien (district) throughout the province. The lack of long-range weather data has handicapped considerably any satisfactory discussion of the climate of the Basin. But, in spite of this fact, the present data, as presented here (Fig. 24), do give us a much better idea of what the climatic conditions of the Basin are than otherwise could have been possible.

a) Temperature.--First of all, the temperature varies considerably within the Basin. The isotherm of the average annual temperature, running in a northwest-southeast direction, in most cases decreases from northwest to southeast (Fig. 24). The temperature is usually mild, as compared with other places having the same latitude. For instance, in the coldest month (January), Chengtu has an average temperature of 5.5 degrees C. (42°F.) (Fig. 22); and the January average for Chungking runs as high as 8.8 degrees C. (48°F.) (Fig. 23 and Table 3). These temperature readings are much higher than places of approximately the same latitude or points even slightly farther north in other parts of China.¹ The average for the hottest months through most parts of the Basin is generally around 28-29 degrees C. (82-84°F.). Thus the typical annual average range is about 4.4 degrees C. (40°F.). The record for the hottest day in the Basin seldom runs higher than 35 degrees C. (95°F.), and the coldest day very rarely drops below freezing. This gives an absolute annual range of about 15.5 degrees C. (60°F.). In most parts of the Basin, the average annual temperature is between 17 and 18 degrees C. (62 and 64°F.) (Fig. 24).

According to the reports of the last ten years (1929-39), Chengtu had an average of about ten days of frost per year, while Chungking had an average of only two days of frost during the same period. For the Basin as a whole (with the exception of isolated hilly areas), the frost-free season, or the growing season, is about 340 days per year. But many parts of the Basin are practically frost-free all the year round. The mildness of the climate certainly has a great deal to do with the agricultural prosperity of the Basin.

b) Rainfall.--Rainfall is a second major element in the climate of the Szechuan Basin. The total annual rainfall throughout the Basin is fairly sufficient for agricultural production. It ranges from 500 millimeters in the northwest to 1,400 millimeters in the southeast (Fig. 24). There are some exceptional cases at the fringes of the Basin. The wettest place on record

¹Shanghai, 3.3°C.; Nanking, 2.2°C.; Hankow, 2.9°C.; Changsha, 4.1°C.; Hankow, 1.2°C.; Wenchow, 7.2°C.; all these cities of about approximately the same latitude or slightly higher northward have lower January averages in temperature than that of both Chungking and Chengtu (cf. Report of the Central Meteorological Station [Nanking, 1936]).

FIGURE 22

CLIMATIC DATA OF CHENG TU

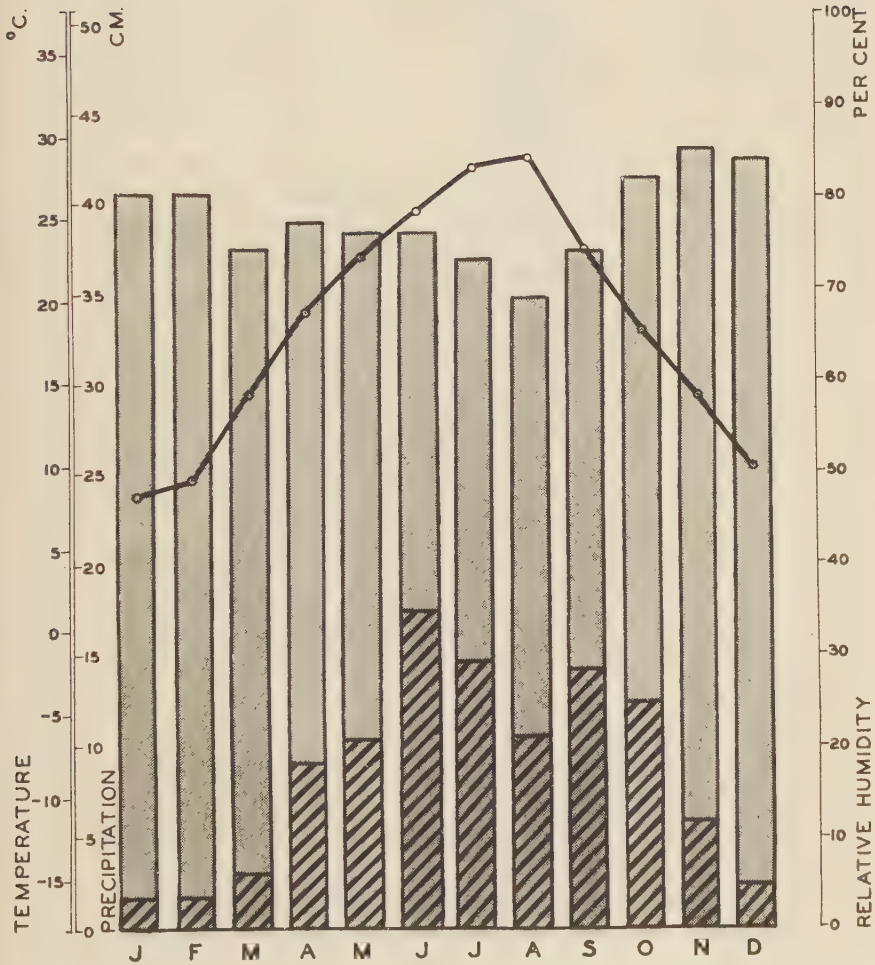
1929-1939



FIGURE 23

CLIMATIC DATA OF CHUNGKING

1913 - 1939



(on the basis of the record of thirteen months, 1932-33), is Omei Shan, which is over 3,000 meters in elevation and has a total annual rainfall of over 7,700 millimeters (Fig. 25).¹

The isohets generally have a northwest to southeast direction. The amount of rainfall increases from northwest to southeast (Fig. 24). In the northern part of Sun-pang district, the rainfall runs as low as 500 millimeters, while in the areas of Peng-shui, Feng-tu, Yu-yang, and Siu-shan the rainfall runs as high as 1,400 millimeters (Fig. 24). The average annual rainfall in most parts of the Basin is between 850 and 950 millimeters (34-38 inches) or thereabouts.

A major portion of the rainfall comes during the summer. However, unlike many other parts of China, particularly the lower and central Yangtse Valley, which is dominated by the monsoon influence, the summer rainy season in the Basin is much longer, and the rainfall is much more evenly distributed throughout the year. For example, the rainy season of Chungking (Table 3) begins generally about the early part of April and ends in the later part of October. The seasonal distribution (in percentage) of annual rainfall in Chungking is as follows (Table 3): Spring, 26 per cent; summer, 41 per cent; autumn, 28 per cent; and winter, 5 per cent. The rainy season is thus definitely longer than in the areas of the central and lower Yangtse Valley.

Moreover, the manner of rainfall and the number of rainy days is even more significant than the total amount and the seasonal distribution. In the Basin the rainfall seldom comes in torrent, but generally falls in a moderate flow, almost in a mist. Consequently, with the given amount of rainfall, the rainy days are many and long-drawn out (Table 3). For instance, in Chungking, Chengtu, and many other areas of the Basin, during the rainy season, generally between the later part of May and the early part of September, the rainy and cloudy days may run as many as 15-20 days per month (Table 3).

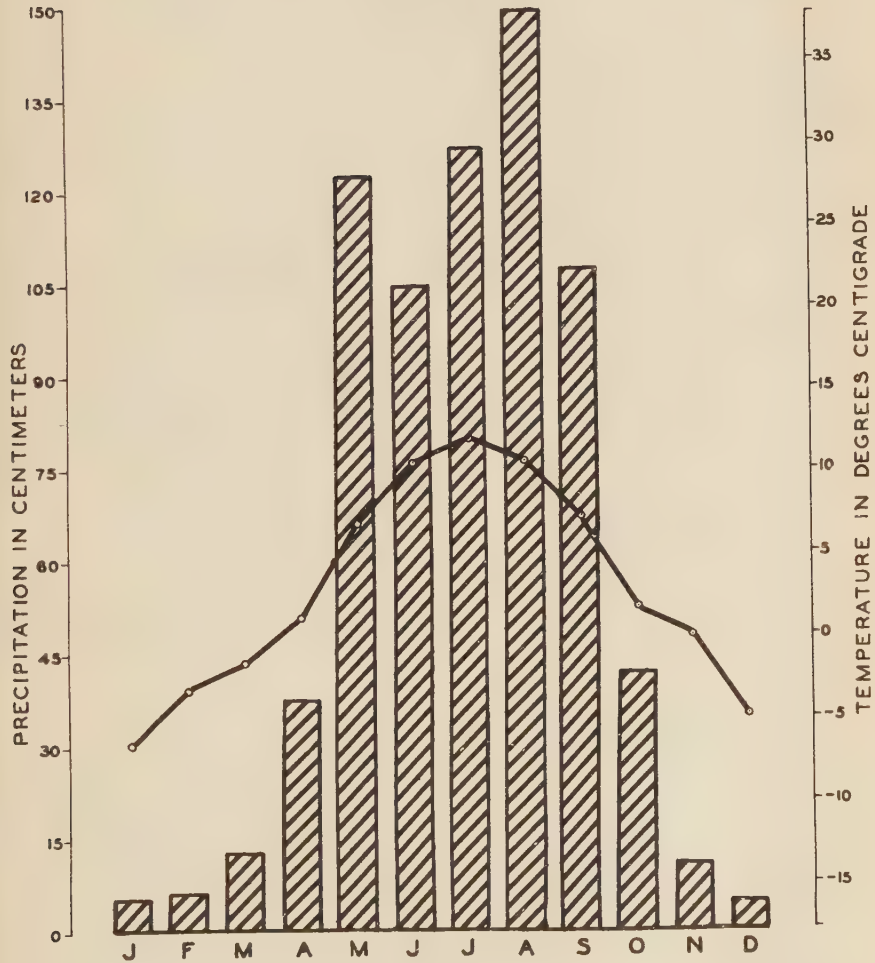
c) Evaporation and humidity.--Ordinarily, in most parts of the Basin, noted for its cloudiness and known as the "cloudy province," the sky remains overcast most (over 70 per cent) of the time during the year. Sun is a rarity in this part of the world. The proverb, "shu chuan fei jih," literally meaning "the Szechuan

¹Bureau of Reconstruction, Szechuan Provincial Government, Annual Weather Report (1936).

FIGURE 25

CLIMATIC DATA OF OMEISHAN

1932 - 1933



dog barks at the sun," is a good testimony to the truth of this generalization. Here, the air is still, and the evaporation rate is low most of the time.

These natural phenomena have a vital practical importance to the prosperity of the agricultural land-use in the Basin. The penetrating and soaking effect of the misty rain on the friable and soft sandstones and shales has hastened weathering and quickened soil renewal. On the other hand, the loose, friable, and shallow purple-brown soils of the Basin are singularly susceptible to torrential rain and quick evaporation.¹ Given a south-China type of summer rainfall, coupled with a north-China type of winter-sunshine, the Szechuan Basin, instead of being one of the richest agricultural regions of China, would long since have been denuded into a desolate and unpeopled wasteland.

On the whole, the rainfall is fairly reliable throughout the Basin. Famines are rare, though drought sometimes threatens fields in more hilly areas.

Finally, the climate of Szechuan Basin is noted for its exceptionally high relative humidity. Chungking has an annual average of 78 per cent, and Chengtu of 80 per cent (Table 3). This high humidity, especially in winter, reduces the demand for rainfall during that season. The same is true, in a lesser degree, for the summer. Foggy and cloudy days are especially frequent, particularly during the winter season. Chungking has an average of 162 rainy and many more cloudy days during the year (Table 3). In the present air-raïd "civilization," high prevalence of cloudiness certainly constitutes one of the great geographic assets of the Basin.

d) Wind velocity.--With the exception of very high hilly areas, the almost complete lack of wind in many parts of the Basin is striking. In most places, the wind velocity averages less than two miles per hour or about one meter per second (Table 3). For instance, in Chengtu city, it is a common experience for the residents there to pass several days without hearing a window rattle, or without observing a breeze strong enough even to change the direction of the smoke! This situation has its geographic significance. Besides its effect on the construction

¹H. Yu, "A Preliminary Observation of the Purple-Brown Soils of Szechuan Province," Soil Quarterly, January, 1941, pp. 39-41.

and style of the house-types of Szechuan, as already mentioned, it has a dominant influence on many special agricultural products here. The notable example is the production of white wax.

In short, the unique Szechuan climate, characterized by moderate rainfall, high average annual temperature (long growing season), high humidity, low evaporation, and virtual absence of wind, is almost ideal for agricultural production.

2. Agricultural Land-Use and Soils

The soil of Szechuan Basin is unique not only by virtue of its red and purple color, which first gave the region its name,¹ but also because of its penetrating, loose structure, its quick formation and renewal, and its relatively high fertility. Generally speaking, there are three major soil groups within the Basin, namely, (1) the purple-brown (forest) soils, which are distributed in most parts of the Basin; (2) non-calcareous alluvium and rice paddy soils, which are concentrated principally at Chengtu Plain and some other minor river valleys; (3) the slightly to moderately podsolized old and young yellow soils, which are found in the peripheral highlands, as well as in the longitudinal anticline areas of the Basin (Fig. 9).

a) Purple-brown (forest) soils.--According to Thorp,² who first made a reconnaissance study of soil conditions in the Basin, and who first offered the generalized map showing the boundaries of various soil groups, the characteristic purple-brown soils consist of slightly acid or neutral, purplish brown, or reddish surface soils, 15 to 50 centimeters thick, underlain by purple clay or clay loam soils, whose depths are seldom over two feet.³ The color varies, depending upon the parental materials. In the western and southern part of Szechuan Basin the soils of this group are frequently reddish purple or reddish brown in color, following the color of their parent rocks. The soils are moderately rich in mineral plant foods, and are particularly tillable.

One of the most interesting physical properties of this group of soils, as recently reported through several experimental

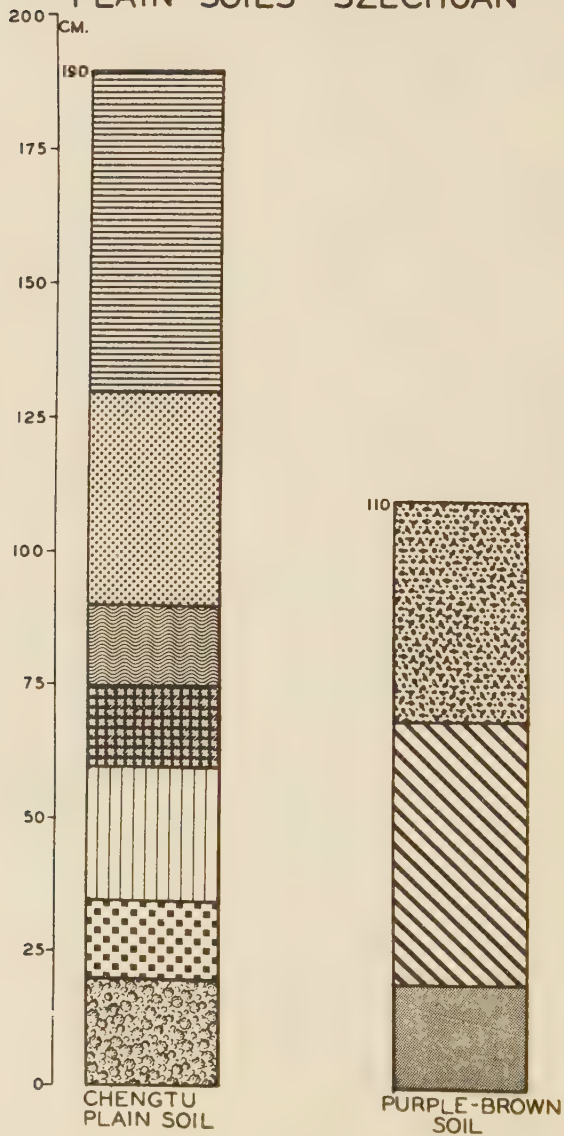
¹Richtofen, op. cit., p. 182.

²Thorp, op. cit., chaps. ix-xii.

³Ibid., pp. 202-204.

FIGURE 26

TYPICAL PROFILES OF THE
PURPLE-BROWN AND CHENG TU
PLAIN SOILS--SZECHUAN



studies,¹ is the rapid rate of absorbing and losing water. It is commonly observed that one evening's thick fog may cause the whole depth of the surface soil to be thoroughly moistened, while a half day's torrential rain may cause the soil to be completely saturated and washed out. On account of this quick rate of absorption the soil can hold little water, and therefore cannot stand a high rate of evaporation. Anyone who has visited the farms here can testify to the fact that after a few continuous clear days the soil often becomes dry and cracked. According to Yu, in June, 1940, after a continuous clear sky for seven days, the water content of this purple-brown soil was so depleted that corn crops withered and suffered a 50 per cent loss that season.² A typical soil profile of the purple-brown soil is shown in the accompanying diagram (Fig. 26).³

The purple-brown soil in most places occurs on the undulating or rolling topography of hilly lands of various heights, ranging from 8 to 10 meters to several hundred meters. The areas with purple-brown soils have been terraced and planted in rice whenever water could be obtained for irrigation. In many places, rice paddies reach the tops of the hills. In case these fields cannot be irrigated, they are used for all "dry" (unirrigated) crops, such as sweet potatoes, wheat, corn, broad beans, and others.

b) Non-calcareous alluvial soils.--Secondly, from the standpoint of agricultural land-use, the most important soil group, though covering relatively a much smaller area than the purple-brown soil, is the non-calcareous rice paddy soils of the Chengtu Plain and some other minor river valleys. They are formed mainly by the alluvial deposits brought down from the rich black soils (chernozem areas) washed down from the Tibetan Borderlands. Generally speaking, in their outer appearance, these soils look very much like soils one commonly sees in the Lower Yangtse Valley. In many places they are dark in color and are mottled in rust. Their textures are fairly heavy and hold water very well. There are also large areas of these rice paddy soils of Chengtu Plain which

¹Yu, op. cit., p. 41.

²Ibid., p. 40.

³Data from Thorp, op. cit., p. 200.

LEGEND FOR FIGURE 26*

Chungking Clay Loam
(Purple-Brown Soil)

<u>Horizon</u>	<u>Depth (Cm.)</u>	<u>Descriptions</u>
A	0- 20	Brownish purple, very friable, and finely granular, moderately porous, loamy clay containing a high percentage of worm excrements. Slightly acid.
B	20- 70	Light reddish purple, friable, medium granular clay which also contains many worm excrements.
C	70-110	Reddish purple soft shale of clay texture. Reaction approximately neutral.

Chengtu Plain Soil

<u>Horizon</u>	<u>Depth (Cm.)</u>	<u>Descriptions</u>
1	0- 20	Dark gray and rust-mottled, friable and porous silty clay.
2	20- 35	Similar to above but slightly lighter colored.
3	35- 60	Reddish yellow and light gray, mottled, stiff clay with a few pores. The soil shrinks considerably while drying. A few small lime and iron concretions.
4	60- 75	Medium gray clay or heavy clay with a few rust specks. The material is stiff and shrinks very much on drying. It contains a few dark brown iron concretions from 1 mm. to 1 cm. in diameter.
5	75- 90	Gray and dark brown mottled, mottled, friable clay with moderate shrinkage when drying. Contains a few soft iron concretions.
6	90-130	Dark brown clay with a few gray streaks.
7	130-190	Dark brown and olive-drab, mottled, loamy clay with friable consistency and a few dark brown concretions.

*Data from Thorp, op. cit., pp. 200 and 387.

show but little evidence of podsolization.¹ A typical profile of this soil is shown below (Fig. 26).² These soils are used principally for rice production and some other crops, such as wheat, tobacco, and various kinds of vegetables. It is necessary to emphasize again the extreme fertility of these soils and the significant part they have played in the agricultural success of the Basin.

Besides the rice paddy soils, on the low hills and high river terraces of part of western Szechuan Basin, particularly in the vicinity north of Chengtu, there are small patches of dark grayish brown coarse soils. Many soil scientists prefer to call these soils "Chengtu Clay."³ Some people believe these "Chengtu clays" were probably true loesses at one time but have lost their columnar structure and are now characterized by prismatic and cloddy structure.⁴

c) Podzolized old yellow earth.--Third, the gray-brown yellow soils occupying the surrounding hills of the Basin are generally less fertile and are agriculturally unimportant.

d) Other soils.--On account of the unique geological structure and rock formations of the Basin, one peculiar form of soil erosion has been extensively developed here. With the alternating beds of purple sandstones and shales which have been recently folded and deeply eroded, and in places where the surface slopes of such smooth rock formations correspond to the slopes of hills, soil creep is easily induced. Many times the thin surface soils have been completely removed, leaving only bare rocks. In the case of shales, on account of their comparatively rugged surface, the situation is less grave. Soil creep constitutes one of the most serious problems of agricultural land-use in the Basin, and challenges immediate attention.

3. Agricultural Land-Use and Topography

With the exception of Chengtu Plain and some other minor comparatively broad river valleys (such as the To and Fou River

¹Ibid., p. 121.

²Ibid., p. 391.

³Ibid., p. 387.

⁴J. Thorp and D. Dye, "The Chengtu Clays, Deposits of Possible Loessal Origin in Western and Northwestern Szechuan Basin," Bul. of the Geol. Soc. of China, X, No. 2 (1936), 225-46.

valleys) most of the agricultural lands of the Basin are found on the terraced fields of the innumerable small undulating rolling hills which are found everywhere in the Basin.

In the many small valleys there is generally very little bottom land along the courses of the streams. These streams, as a rule, have deep channels and abrupt banks of sandstones and gravel-conglomerate. But, wherever such bottom lands exist at all, they are extremely fertile. They are, in most cases, terraced for rice culture, provided water can be secured. It is not unusual to observe that tracts after tracts of rice and other crop fields have been terraced along the steep banks of these small valleys.

Generally speaking, the agricultural fields, according to the popular classification commonly used by local peasants, consist of four principal categories, namely, (1) Pa Tien, or plain fields, i.e., fields around the smooth level, flattish fields or broad river bottoms; (2) Kou Tien, or valley fields, within narrow river valleys; (3) Ti Tien, or ladder fields, i.e., terraced fields along hills or any other steep lands; and (4) Shan Tu, or hilly "earth," i.e., detached fragmentary lots on hills or mountains which are too rugged and too difficult for terracing and for cultivation purposes. The relative value of these four classes of land, of course, decreases in the order named. It is particularly interesting to note that the first three categories are real "fields" whereas the fourth is merely "tu" or "earth."

Fields devoted to categories (1) and (2), and some portions of category (3) are in most cases used for wet crops (rice), whereas large portions of categories (3) and (4) are confined to dry (unirrigated) crops. The difference between these two types of land, both in the manner of utilization and in their relative value, is as sharp as the difference between pasture land and farm land in western agriculture.

In short, here in the Basin the topography furnishes one of the dominating forces in shaping many of its geographic patterns. First of all, it practically dictates the whole climatic regime of the region, which, in turn, affects the soil conditions. And all three operate in combination to account for the present patterns of agricultural land-use.

4. Agricultural Land-Use and Water Resources

a) Importance of irrigation in the Basin.--A prominent German authority on the agrarian economy of China once pointedly remarked: "Everywhere in China irrigation is an indispensable condition for the intensive agriculture on which Chinese agrarian society is based, just as coal and iron are an indispensable condition to the industrial society on which modern capitalism is based."¹ This statement is particularly applicable to the situation in Szechuan Basin. Here, in spite of the moderate rainfall and low evaporation, the need for irrigation is essential for the success of many crops, especially rice.

b) Principal methods of irrigation in the Basin.--There are many different kinds of irrigation practices in the Basin. Each of these methods is equipped with a different device, and is adjusted to local topography and to the local source of water supply. Generally speaking, the methods may be classified under five main groups:

(1) Grade or gravity irrigation.--This practice involves the division and diversion of the upper reaches of a river of comparatively moderate grade into small branches. Such branches are led, by the force of gravity, into valley fields at a lower level and then arranged so that they drain back into the main river farther down stream. This method is practiced in nearly every part of the Basin where a valley plain can be found, since the grade of most streams here is appreciable. The method is particularly widely practiced in the areas along the lower Min River, between the Peng-shan and Lo-shan districts.

(2) Wind-wheel irrigation.--In areas where rivers have deeply eroded channels, frequently as deep as 30 to 40 feet below the surrounding land in the soft sandstones, and where the grade is great, the swift-flowing streams are utilized to lift the water for irrigation use by bamboo water-wheels. These undershot irrigation water-wheels, with delicate structures of bamboo buckets on their periphery, can raise water into a flume from 30 to 75 feet above the level of the stream (Fig. 27). They are particularly popular in the Tung-chuan and Tze-liu-ching areas of the Lower To River Valley.

¹K. A. Wittfogel, Wirtschaft und Gesellschaft Chinas; versuch der Wissenschaftlichen analyse einer grossen asiatischen agrargesellschaft (1931), p. 229.

(3) The "Lung-ku-chiao" or "dragon-bone-chariot" irrigation method.--In areas where the water flow is not sufficient to turn water-wheels, the old "dragon-bone-chariot," or the foot-power water elevator, which is found in many other parts of China, is used. It is a long, narrow wooden trough affair, open at both ends, with one end submerged in the water, and equipped with a chain of wooden pedals. It is a sort of step-up device, like a western escalator, operated by the foot-power of usually two or more persons. The water is lifted from one field to another of higher level. This device is also commonly used in hilly areas to lift water between terraced rice fields. It is particularly popular in the Kuang-hang and Te-yang districts.

(4) Storing-water-field or reservoir field irrigation.--As already explained, throughout the hilly areas of the Basin, it is a common practice to store water in fields during the winter season for spring or summer crops. As rainfall in the Basin is highly seasonal, some reservoir for the run-off from the immediately adjacent hills is necessary. Certain fields, in hollows well up the sides of slopes of terraced lands, are set aside as reservoirs. They are kept as nearly full as possible to tide the farmers over the periods between rains and between crops. This method, of course, necessitates the husbanding of all the rain water and run-off during the fall season in order to lead them into these field reservoirs.

(5) Ditch or canal irrigation.--This method involves the tapping of a stream at its upper reaches and then branching it into multitudes of anatomized channels and ditches for irrigation purposes. This system is by far the most important in the Basin. It is practiced in a number of river deltas, such as the To, the Fou, and the Min. The outstanding example is the Tu-chiang-yen works (Fig. 28) on the Min River in Chengtu Plain. A detailed discussion of this great work and its significance to the agricultural land-use of the Basin will be made later in connection with the agricultural area of Chengtu Plain.

D. Principal Agricultural Areas of Szechuan Basin

On the basis of crop association, relative prosperity of agricultural production, general appearance of agricultural landscape, use of water for agricultural purposes, and the degree of commercialization of agricultural production, the Basin may be

roughly divided into five principal agricultural areas (Fig. 24), namely, (1) the general grain farming area of Chengtu Plain; (2) the specialized "commercial" agricultural area of lower To-Fou valleys; (3) the self-sufficient subsistent agricultural area of the northern Basin; (4) the combined agricultural and forestry area of the eastern Basin; and (5) the mixed farming area of the southwestern Basin.

1. The General Grain Farming Area of Chengtu Plain

Among all the five agricultural areas of the Basin, the general grain farming area of the Chengtu Plain is by far the most important. Here the principal crops are rice and wheat, supplemented by rape seed and tobacco.

As the heart is to the human body, Chengtu Plain is to Szechuan Basin. Chengtu Plain is one of the richest, most fertile, and best known geographic regions of all China. With its mild climate, level topography, fertile and self-renewing soil, the ingenious ancient irrigation systems, and the diversity of agricultural products, Chengtu Plain is destined to be not only the granary of the Basin but also the par excellence "Eden of the Flowery Republic." Strictly speaking, Chengtu Plain is a highly fertile level oasis within a huge "mountain-desert."

a) Name and location of the Plain.--Geographically, the term "Chengtu Plain," by which this region is now known, is not accurate, and is, in fact, somewhat misleading. Chengtu, the capital and the wealthiest city of the whole Basin, from which the Plain now derives its name, is, in fact, an "effect" or a "result," but not a "cause." Strictly speaking, the "Plain" might be more correct, or even more appropriate geographically, to assume the name, "the Min River Plain." It is the presence of the mighty Min, with its incessant life-promoting water-supply and the rich alluvial deposits it brings down, that made the prosperity of the city of Chengtu and of the whole Plain possible. It is interesting to note that unlike historic events, geographic names do not always follow the law of "cause and effect." The river made the plain, and the plain made the city, but now the plain takes its name from the city.

Chengtu Plain is situated at the northwest corner of Szechuan Basin. It is formed by a complex of piedmont alluvial fans built by the deposits of the Min River. Physiographically,

it is a clear-cut geographic sub-region within the clear-cut geographic region of Szechuan Basin. Like the latter, Chengtu Plain is practically surrounded by mountains (Fig. 2). To the north and northwest, the Plain is bounded by the lofty Chiu Ting Range, which, on clear days, looks like a high wall in front of the Plain. To the east and southeast, the Plain is bounded by the famous Lung Chuen-I anticlines, a low and uniform range (Fig. 2).

b) Layout and extent.--In rough outline, the Plain is in the shape of a somewhat long and narrow triangle.¹ Its longest dimension, from Chiang-ko in the south to Hsao-shui-ho, beyond Mienchu Hsien, in the north, is about 120 kilometers. Its widest dimension, from Chao-chia-tu in the east to Kuan-hsien in the west, lying almost in a straight line, is about 85 kilometers (Fig. 7). From Tsung-Nai in the extreme southwest to Te-yang-hsien in the northeast, the distance is about 115 kilometers (Fig. 7). The circumferential boundaries are very irregular. The total area is about 6,000 square kilometers. Chengtu, the provincial capital, and fourteen other walled cities, are situated in this Plain, together with many unwalled towns of large size. Farmhouses dot the Plain in every direction.

Chengtu Plain is genetically an alluvial delta, built up by deposits from the Min River, but structurally it assumes a basin-like shape surrounded by mountains. This fact is indicated by the direction of the flow of the Min River. The Plain has an elevation ranging from 1,500 feet above sea level in the south and east, to 2,100 feet in the west and northwest. Its average elevation is estimated to be 1800 feet above the sea.²

c) Geological deposits and soils.--Geologically, the Plain is of very recent origin. The alluvial deposits (Fig. 29) of the Plain are seldom over 60 meters deep, below which depths are found the famous conglomerate formations of the Basin.³ At Pen-hsien and in many other places it is reported that the surface deposits are only 12 meters in depth. But in Chengtu district the alluvial

¹See Figure 37.

²Chao and Huang, Geology of the Tsinling Shan and Szechuan (Geological Survey, China; Memoirs Ser. A., No. 9, 1931), p. 18.

³G. Barbour, Physiographic History of the Yangtse (China Geological Society; Geological Memoirs Ser. A., No. 14, 1935); and Chao, "Geological Notes on Szechuan," Bulletin Geological Society (China), VIII, 143.

deposits are generally about 5 to 7 meters deep.¹ It is estimated by some geologists that the rate of the alluvial deposition in Chengtu Plain is at the rate of one foot per century.² This assertion and calculation is independently evidenced by recent archaeological excavations near the vicinity of Chengtu. Burial objects of unmistakably Early Han dynasty were discovered at a depth of about seven meters (or about 21 feet).³ In other words, the geological time of these deposits corresponds fairly closely with the historical times as manifested in the age of the buried Han objects, i.e., both are about 2,100 years old. If both of these assertions are correct, i.e., the deposition at the rate of one foot per hundred years, and the maximum deposit being not over 60 meters (or 180 feet) deep, the age of this celebrated rich Chengtu Plain can be no more than 20,000 years.

It is interesting to note that as late as the Han dynasty, large parts of the Chengtu Plain were still swampy in nature. This is evidenced by the fact that the most prosperous settlements at that time were not in Chengtu and its surrounding cities, but rather at Ling Tsung (the present Tsung Nai) and the more elevated hilly areas of the Plain.⁴

In addition to the rich, young alluvial deposits, Cheng-tu Plain is further favored, as we shall see later, by the excellent and ingenious irrigation systems, devised by the revered Li Ping and his son about 2,200 years ago. These irrigation systems freed this Plain once and for all from the danger of drought and flood. Here, multitudes of canals and ditches, filled with irrigation water, run through the rice paddy, fields, vegetable tracts, and flower gardens. Through some ingenious devices, as we shall see later, silts are dug off and the principal channels cleared once every year.

The Plain has the further advantage of being watered by streams rising in the mountains where the rainfall is much heavier than that in the Plains, and where the water-supply from snow

¹Ibid., p. 38.

²D. S. Dye, Journal of West China Border Research, IV (1931), 104.

³C. T. Shan, "Archaeological Report on the Excavations of Chengtu Plain Areas," Cultural Research Monograph (University of Nanking, 1939). (Unpublished manuscript.)

⁴Hua Yang Kuo Chih, Chuan 2, p. 15.

melting during the summer is reliable. At Kuan-hsien, where the torrent of the Min first enters the Plain and is taken under human control, the waters are divided into several large canals, each of which is subdivided in turn into innumerable smaller canals and ditches. The life-giving waters are impounded by dams, stone revetments, and other devices, and are held for irrigation purposes. The irrigation of the Plain has another advantage in that the soils are seldom troubled by salt and fine mud which often clog irrigated soils in other areas; because the considerable rainfall in Chengtu Plain, with an annual average of about 900 millimeters, is sufficient to prevent such clogging.

The soils of Chengtu Plain consist principally of the dark and dark-gray paddy soils. They are formed mainly from alluvial deposits brought down from the rich black soil (chernozem) of the Tibetan border-land and Kokonor (Fig. 9) by the mighty Min River. The natural richness of these soils is enhanced even further by the annual renewal. Because of this fact, soils of the Plain, unlike the paddy soils of many other parts of China, are not strongly podzolized.¹ However, the soil conditions do not appear to be uniform throughout the whole Plain. In fact, there are considerable differences in texture, color, and profile according to slight differences in local relief.² For instance, in the upper Min River region, as in Kuan-hsien, the soil texture is much coarser than in the lower Plain areas.³

One of the most interesting practices in connection with soil culture in the farms of Chengtu Plain, is the building of little stone wing dams or projections along the stream banks out into the water. Behind these projections, the streams, in the course of a back eddy, deposit silt and sand, which are frequently rich, particularly in organic matters. All these mud accumulations are carefully dug out and carried in baskets to the fields. Many times muddy waters have been led into basins or rice paddies in order that fine fertile silt might be precipitated on the fields.

d) Agricultural products of Chengtu Plain.--The Plain is noted for its diversity of agricultural products. It produces

¹Thorp, op. cit., p. 391.

²Ibid., p. 387.

³Ibid.

three and sometimes four crops a year. It is estimated that the annual output of farm products alone include rice, 15,000,000 piculs; wheat, 8,000,000 piculs; other cereals, 2,000,000 piculs; rape seed, 500,000 piculs; tobacco, 700,000 piculs; plus medicinal herbs, vegetables, and other farm products. The total value of all these products at pre-war prices was a little over 180,000,000 dollars, or 45 dollars per capita for the Plain. This production represents about 15 per cent of the total volume of agricultural produce of the whole province, while the area of the Plain is only about one-sixty-seventh of the total area of the province. In other words, the Chengtu Plain produces ten times as much per unit area than the rest of the Basin.

e) Farms and fields.--Among the farm areas of the Basin, Chengtu Plain has the largest average farm. According to a survey by Professor Brown and M. L. Li, the rented farms average 30.1 mow, and the owned farms average 73.1 mow.¹ These figures are almost twice as large as the average size of farms in the Basin as a whole.² They are, in fact, even larger than the largest average size of farm in North China.³ This, of course, means additional wealth and more prosperity. This undoubtedly has accounted for the large farmstead and the well-kept farms throughout the Plain (Fig. 12). Moreover, unlike other parts of the Basin, most of the farms here are not so detached. In general, the individual fields of Chengtu Plain farms are larger. According to the same survey, the average field is 3.36 mow,⁴ which is three times as large as that of the hilly areas in the Basin.⁵ Larger fields are made possible, of course, by the flatter topography and better water-supply here.

f) Marketing of agricultural products.--The marketing of the diverse agricultural products of the Plain is interesting. Marketing is done mainly in the nearby towns or cities throughout the year. The Plain is dotted with market towns, so that all

¹H. D. Brown and M. L. Li, "A Survey of Fifty Farms on the Chengtu Plain," Chinese Econ. Journal, I (1927), 1-59.

²Ibid.

³Buck, op. cit., p. 273.

⁴Brown and Li, op. cit., p. 28.

⁵H. D. Brown and M. L. Li, "A Survey of Farms of Mountain Omei Areas," Chinese Econ. Journal, I (1927), 1059-76.

farms here are within a few miles of a market. Each town has usually three or four market days per week, which alternate with those of the neighboring towns. The larger places have a daily market. The produce is usually carried on men's backs on shoulder poles, or loaded on wheelbarrows. The noise of the wheelbarrows on the stone-paved roads in the quiet of the early morning is as genuinely Chengtu Plain as many of its other unique landscape features. This peculiar noise, together with that much-advertised smell of night soil in the oriental farm fields, adds another unique double feature to the already too-colorful Chengtu-Plain landscape.

Moreover, in spite of the obstruction of irrigation dams, the extensive inter-communicating canal systems in the Plain help provide channels by way of which many of the villagers in the Plain can send their produce (such as vegetables, fruits, poultry, pork, and other products) to the city or to other towns by boat. And at the same time they bring home their purchases by the same conveyance. The canals thus facilitate considerably the otherwise very difficult transportation conditions. Here reminds one of the similar scene, though on a much smaller scale, which is commonly seen in the Great-Lake Canal regions (such as the Wu-shih and Soochow areas) of the Lower Yangtse Delta.

g) Practice of aquiculture.--Because there are thousands of acres of ponds and water-covered paddy fields in Chengtu Plain, aquiculture is also practiced here. The principal activity along this line is fishing--for fish, frogs, snails, and crabs. Cormorant fishing is particularly characteristic. Because the Min River and other streams in this area are fairly clear during some months of the year, the fish can be easily seen as they hurry upstream to spawn. Thus, the cormorant catch is generally very successful here. Other phases of aquiculture include digging for aquatic plants, such as lotus seeds, water chestnuts (*Trapa natans*), and *Calladum*, which are all delicacies to the people here.

Chengtu Plain occupies an area of approximately 6,000 square kilometers, about one-twenty-fifth of the total area of the Basin proper, as delimited in the present study. But it has a population of more than 4,000,000 people, or about one-twelfth of the total population of the province. The average population density of Chengtu Plain is a little over 700 persons per square kilometer, or nearly 1,800 persons per square mile. Nowhere in

China, with the possible exception of the Lower Yangtse Delta region, is the average population density so high. It is, of course, made possible only by the tremendous productivity and the intensity of agricultural land-use in the Plain.

h) Irrigation works of Chengtu Plain--Tu Chiang Yen as the nerve center.--The Tu-chiang-yen irrigation works, built 2,200 years ago, when applied science was yet unknown in Europe, is one of China's best known ancient engineering feats, and is one of the two oldest irrigation works in all China. It is this system which is largely responsible for the fertility of Chengtu Plain, commonly known in Chinese history as the "Heavenly country." It is also because of this system that this "Heavenly country" has experienced only 17 minor droughts and floods in the last twenty-two centuries.

(1) Historical development.--The Tu-chiang-yen system was devised to harness the waters of the mighty Min¹ on their way down from the Tibetan Plateau in order to irrigate the farm-lands in 14 districts of western Szechuan Basin. According to Shih-Chi, in the earliest Chinese historical Annals,² the system was first constructed by General Li Ping and his son, in 316 B.C., immediately after the conquest of Szechuan (then the Shu State) by the feudal Chin State (Shensi). The annals read: "In Shu (Szechuan), the governor cut a canal through Chengtu to connect the navigable rivers in the region into one system."³

¹We owe to the Ming explorer and geographer, Hsu Hsia Ke (1586-1641) the first appreciation of the actual relationship between the present Yangtse and its tributaries, as understood today. It is interesting to note that prior to his clarification, the Chinese for centuries, regarded the Min, because of its huge volume and torrential flow, as the upper stream of the Yangtse itself. It was not until Hsu Hsia Ke, who first ascended the Yangtse, that it became an established fact that the Ching Sha River was the upstream of the Yangtse itself. This was about one century earlier than the Jesuit Fathers who first compiled the Celebrated Atlas of Imperial China (cf. V. K. Ting, "Hsu Hsia Ke, Explorer and Geographer," New China Review, III [1921], 336-37).

²Ssu Ma Chien, Historical Annals, Vol. XXIX, Books on Rivers and Canals, p. 2.

³During recent years, a number of students of the subject have refused to accept the fact that Li Ping was the builder of the system, and have asserted that a man named Pieh Ning or Kai Ming (a minister of the Shu State) initiated these irrigation works, several hundred years before Li Ping. They contend that Li Ping only extended the system and improved it, but did not

(2) Layout and extensions.--The whole Tu-chiang-yen system, with its pivotal point at Kuan-hsien where the torrent of the Min first enters the Plain, is roughly triangular in shape (Fig. 30). With Kuan-hsien as the apex, and the line from Chengtu to Sin-tsin as the base of the triangle, the system covers an area of 3,500 square kilometers, or 5,200,000 mow, which is much smaller than the total area of Chengtu Plain. It includes altogether fourteen districts, namely, Kuan-hsien, Pi-hsien, Peng-hsien, Tsungning, Sin-fang, Kwang-hang, Chin-tang, Chengtu, Sin-tu, Wen-chiang, Hua-yang, Tsung-ching, Shuan-liu, and Sin-tsin (Figs. 30 and 37). From Kuan-hsien to Sin-tsin and Chengtu, the drop is rather gradual and uniform, averaging about seven to eight meters per kilometers, a grade of hardly half a degree, or less than one per cent¹ (Fig. 5). This moderate and even slope has proved to be very favorable for building irrigation channels.

The system is divided by Tu-chiang ("Fish Mouth")² break-water, an inverted V-shaped dike (Fig. 31). At Kuan-hsien, the river is divided into two main channels, the Nei-chiang (inner river) and Wai-chiang (outer river). The Wai-chiang is the main channel of the Min River. It is further divided into five channels, which are, from west to east, the Sha Kou, Hei Shih, Cheng Nai, Chiang An, and Ching Ma streams (Fig. 30). All these channels, with the exception of the last, flow nearly due south. Together with their more than 158 subdivided canals,³ they carry water to farms in the seven districts of Kuan-hsien, Pi-hsien, Wen-chiang, Shuan-liu, Hua-yang, Tsung-ching, and Sin-tsin. Finally, all these channels of the Wai-chiang join at Chiang-ko, about forty-five miles south of the city of Cheng-tu.

initiate it. This view, however, is not widely accepted in China (cf. Chang Chu's work entitled "Shu Chih" [the Gazetteers of Shu State], a work of Chin dynasty [265-419 A.D.] and a series of articles by J. Vale, "Irrigation Works of Chengtu Plain," Journal of North China, Branch of the Royal Asiatic Society, XXXIII (1900), 105-19, and XXXVI (1905), 36-50.

¹Bureau of Reconstruction, Szechuan Provincial Government, A Report of the Tu Chiang Yen Irrigation Works (1933).

²Ibid., p. 28.

³S. F. Swen, "The Engineering Works of the Tu Chiang Yen Irrigation Project," Topographical Magazine, VII, No. 6 (1931), 18-27.

FIGURE 30

PRINCIPAL IRRIGATION CHANNELS CHENG TU PLAIN

- | | | |
|----------------|---------------|-----------------|
| 1. Chengtu | 5. Wen-chiang | 9. Chao-chia-tu |
| 2. Shuan-liu | 6. Pi-hsien | 10. Sing-fang |
| 3. Sin-tsing | 7. Sin-tu | 11. Tsung-nin |
| 4. Tsung-ching | 8. Ching-tang | 12. Kuan-hsien |



LEGEND

- DISTRICT CAPITAL
- - - DISTRICT BOUNDARIES
-  IRRIGATION CHANNELS
- . - . ROADS

0 10 MILE
0 10 KILOMETER

C. Y. H.

Data from the Bureau of Reconstruction, Szechuan

The Nei-chiang is divided into three channels, which are, in the south to north order, the Chou Ma, Pai Tiao, and Pu-yang streams (Fig. 30). The most southerly one, the Chou Ma stream, flows nearly due east and irrigates the districts of Pi-hsien and Cheng-tu. The central one, the Pai Tiao stream, flows northeast, and irrigates the western and northern parts of the above-named districts. Branches of these two streams flow past the south and north walls of Chengtu city, uniting near the east gate of the city. The northern-most channel, the Pu Yang stream, flows towards Peng-hsien, and then southeastward past the Kwang-hang district. At Chao-chiao-tu of Ching-tang (Fig. 30), the Pu Yang stream, together with numerous anatomizing canals, forms the headwaters of the To River and flows due south past the famous salt well areas of Tzu-liu-ching, and finally enters the Yangtse at Lu-hsien (Fig. 7). These three main channels of the Nei-chiang are further divided into more than 130 canals,¹ which are used to irrigate farms in eleven districts of Kuan-hsien, Tsung-ning, Peng-hsien, Sin-tu, Sin-fang, Ching-tang, Kwang-hang, Cheng-tu, Pi-hsien, and Hua-yang.

The natural tendency is for the Wai-chiang to get more of the flow, while the Nei-chiang gets less. But the human effort has been to reverse this tendency, so that more water may be available for irrigation purposes in the Nei-chiang. At present, the ratio of the flow is about 60 per cent to the Nei-chiang and only 40 per cent to the Wai-chiang.²

The nerve center of the Tu Chiang Yen Irrigation Works, from the Pai Chang Ti, the "Thousand Foot Dike," at the north, down to Pao Ping Ko Cliff at the south (Fig. 31), extends for a total length of approximately 4 li. The "Thousand Foot Dike," at the northern-most end of the works, was built of heavy gravel stones and rocks (taken from local hills), to direct the current to the Tu Chiang Yen "Fish Mouth" below it. Behind this dike, a 500-meter bamboo suspension bridge, the "An-Lang-Chiao," or the "Pacifying Wave bridge," spans the river. Under the bridge is the Tu Chiang Yen "Fish Mouth" breakwater, which, as already mentioned, serves as the pivotal point (in an inverted V-shape) at

¹Ibid., p. 21.

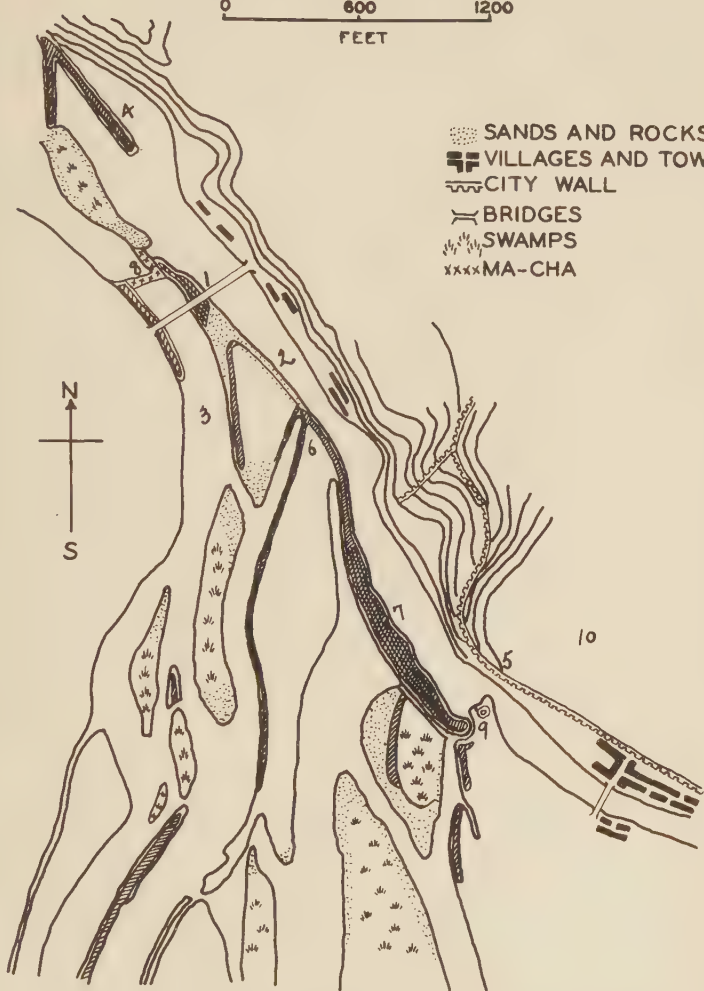
²T. M. Pao, "The Irrigation Works of Chengtu Plain," Nankai University Publication (1938), p. 36.

FIGURE 31

THE DETAILED LAYOUT OF THE TUCHIANGYEN IRRIGATION WORK

0 600 1200
FEET

-  SANDS AND ROCKS
-  VILLAGES AND TOWNS
-  CITY WALL
-  BRIDGES
-  SWAMPS
-  MA-CHA



- | | |
|-------------------------|--------------------|
| 1. Tu Chaing fish mouth | 6. Ching Kan dikes |
| 2. Nei Chiang | 7. Flying sand Dam |
| 3. Wai Chiang | 8. Ma Cha |
| 4. Thousand Foot dike | 9. Li Tui |
| 5. Pao Ping Kou | 10. Kuan Hsien |

C.Y.H.

Data from the Bureau of Reconstruction, Szechuan

which the flow of the main river is split into two principal channels, the Wai-chiang (the outer river) and the Nei-chiang (the inner river) (Fig. 30). This breakwater was originally built of rocks, protected by baskets of egg-shaped gravels, but was rebuilt in 1935 of rock and reinforced concrete.

Besides the "Fish Mouth" breakwater, there are two long dikes, known as the Ching-Kan-Ti (Indestructible Buddha Dikes), made of large stones, to control the direction of the flow (Fig. 31). Two additional dikes, the Fei Sha Yen, made of baskets of gravels, serve as overflow dams to divert excess water in the spring from the inner river to the outer river, and to redirect it in the dry season from the outer river to the inner river.¹

The entire system requires annual repairs and dredging, and a thorough dredging every five years, besides occasional emergency repairs. The annual dredging takes place in winter when the river is low. A dam is constructed across the mouth of the outer river. Water is prevented from rushing into this channel by means of baskets of stones held together by wooden tripods and protected by reeds and clay (Fig. 32). After the outer river has been dredged and repaired, a similar dam is erected across the mouth of the inner river. Known locally as "Ma-Cha," these tripods are eight to ten meters high, and are made of local materials. From 40 to 50 such tripods are needed to stop the flow of the outer river, and 60 to 70 tripods are required for the inner river.² At the beginning of April, when all repair and dredging work is completed, the dam is opened simply by cutting the tripods and removing the reeds.

At the foot of the western wall of Kuan-hsien city, in the southern extension of the Tu Chiang Yen Works, Li Ping cut a channel through the rocky Litui hills (Fig. 31). This channel, known as Pao Ping Ko, the "precious bottle-neck," which it indeed is, serves as an outflow for the Nei-chiang channels, and is another key point of the whole Tu Chiang Yen Works. It holds the fierce rush for an instant and deflects it at a sharp angle to the north. Water marks are cut on the Pao Ping Ko Cliff. And in the bottom of the river a little above the Cliff, there is an iron

¹Bureau of Reconstruction, Szechuan Provincial Government, Tu Chiang Yen Irrigation Works (1933), p. 26.

²C. S. Mao, Irrigation Works of Chengtu Plain (1934), p. 18.

bar to indicate the depth of dredging required each year.

Aside from being noted for the virtue of being easily-built and easily-maintained, the original construction of the Tu Chiang Yen Irrigation Works has the special merit of making use of the local cheap raw materials, such as bamboo and rocks, for its entire construction. Besides the "Ma-Cha" tripods, Tu Chiang Yen calls for the use of local materials in the construction of gravel basket containers which are also necessary for the irrigation works. A special "white shell bamboo" produced in the hills about 50 kilometers west of Kuan-hsien and famous for its strength, is used for these containers. The "white shell bamboo" groves are not allowed to be cut for any other purpose. The bamboo is rafted to Kuan-hsien and made into baskets 30 feet long and 1.7 feet in diameter, weighing 100 catties.¹ Filled with gravel, they are placed at the outer sides of the dikes and dams to protect them against rapid currents. These baskets hold together easily and stay intact in spite of the wash. They have proved their special effectiveness for hundreds of years. They have been used ever since the Wan Li period of the Ming dynasty.²

In the excellent upkeep of these age-old irrigation works, which have been operating successfully for thousands of years, the engineers have all followed faithfully a few terse instructions enunciated by the original builder. These are: "Shen Tao Tan, Ti Tso Yen, Yu Wan Chieh Chih, Feng Chen Chou Hsin," literally meaning "Keep the dikes low, dig the channel deep; straighten out the curves, gouge out the center." These words, now carved in big letters (Fig. 33) on a monument at the Shrine for Li Ping and his son, echo the wisdom of this great hydraulic engineer.

The long success of this unique irrigation project is known throughout China, and has often been lauded by Chinese writers. But it was F. von Richtofen, the eminent German geographer, who first publicized its excellence to the western world.³

The works are now managed by the Tu Chiang Yen Construction Engineering Administration of the Szechuan Provincial Reconstruction Bureau. Besides directing the annual dredging and

¹Tu Chiang Yen Irrigation Works, op. cit., p. 41.

²Fan Tsan Yang, et al., Szechuan Tung Chih (Gazetteers of Szechuan Province), Chuan 146, p. 8.

³Richtofen, op. cit., pp. 228-34.

repairs, this Administration has also introduced numerous modern technological improvements in order to increase the durability and effectiveness of the project.

Recently, a hydrographic station has been established at the Erh Wang Shrine by the Administration to study the flow of the Min River. Projects are under way to harness the river's maximum flow of 9,500 cubic meters per second¹ to generate electricity for the Chengtu Plain. Two small hydro-electric plants are in operation at Chengtu and Ching-tang.² The Administration is contemplating building a 12,650 kilowatt power plant at Kuanhsien. A 23-kilometer canal will be cut to link the Inner and Outer rivers between Wen-chiang and Chengtu to maintain the Chengtu city water-supply and navigation between the two rivers. The Administration also has plans for the dredging of the existing canals and the digging of new ones to control more effectively the flow in both rivers, and to repair the tributary creeks to increase by another 600,000 mow the farms irrigated by the system, and eventually bring the entire Chengtu Plain under irrigation.

Among all the geographic features of Szechuan Basin, the Tu Chiang Yen Irrigation Works holds the key to the sustained prosperity of the agricultural land-use of the Basin, particularly of Chengtu Plain. Indeed, it commands the special attention of all geographers.

2. The Specialized "Commercial" Agricultural Area of Lower To-Fou Valleys

Comparing to the General Grain Farming area of Chengtu Plain, this agricultural area of Lower To-Fou valleys (Fig. 24) is noted by its specialized "commercial" products, such as sugar-cane, cotton, mulberry trees, and citrus fruits. About 85 per cent of the Basin's total production of sugar-cane, 65 per cent

¹Pao, op. cit., p. 48.

²According to the recent (1935) survey by Huang Hui, a prominent hydraulic engineer of the National Reconstruction Commission, it is highly feasible to develop multiple purpose water-power projects in the upper reaches of the Min, where the present source of irrigation water originates. These projects, if established, would also benefit the irrigation works, particularly by lightening the annual dredging work and reducing the operation costs (cf. section on "Potential Water-Power Development of Szechuan," Report of Chinese Engineer's Association Investigation of Szechuan (1936)).

of its total cotton, and 55 per cent of its silk are produced here in this agricultural area.

With its combined and greatly varied agricultural and horticultural products, this area compares favorably (in terms of agricultural prosperity) to that of the Chengtu Plain. But, however, unlike the Chengtu Plain, the agricultural land-use of this area is greatly handicapped by its insufficient supply of water for irrigation. This defect is largely due to the prevalence of the high porosity of the bed rocks¹ in this area, where water cannot be accumulated and stored up for irrigation purposes. This condition is especially detrimental to rice culture which requires flooded fields. Consequently, in many districts of this area, the plantation of rice is greatly limited. This factor, in turn, reduces considerably the agricultural prosperity of the area.

In so far as agricultural land-use is concerned, the adjustment to topography, soil conditions, and water supply here is conspicuous. In general, nearly all the alluvial lands along the river banks are used for rice, sugar-cane, cotton, mulberry trees, and other crops. On the saddle areas between hills, if the surface soil and bed rocks are not too loose or porous, paddy fields are always the rule. In the more hilly areas, where water cannot be stored for rice culture, potatoes, rape, wheat, kaoliang, and beans are the dominant crops.

Among all the agricultural areas of the Basin, this area of the lower To-Fou valleys is the most highly commercialized. For instance, in one district, Sui-ning alone, over 65 per cent of its cultivable land is devoted to cotton culture, whereas in Tze Chung district over half of its cultivated land is used for sugar-cane culture. In the actual rural economy, here, more than in any other agricultural area, farmers think more in terms of their "cash crops." This development brings up a very interesting problem in this agricultural area, that is, its insufficiency of food supply. Consequently, considerable amounts of foodstuffs are brought into here from the nearby Chengtu Plain area.

Other outstanding features of this agricultural area includes its high population density (Fig. 10) and rich salt deposits.

¹T. S. Chen, "Geol. Structure of Central Szechuan," Geol. Bi-monthly, IV, No. 6 (1939), 35.

3. The Self-sufficient Subsistent Agricultural Area of the Northern Basin

North of Santai in the west and Ho-chuan in the east (Fig. 24), almost in a straight line, lies the self-sufficient subsistent agricultural area of the northern Basin. This agricultural area is characterized by its more rugged and dissected topography, more irregular hills, and higher local reliefs. These conditions are particularly true in the northern half of the area at the vicinity of the upper Fou and Chialing valleys.

The most interesting aspect of this agricultural area, as its name implies, is its ultra self-sufficient and subsistent character of its agricultural practices. Although most of the agricultural areas of the Basin are principally subsistent in nature, the present agricultural area of the northern Basin represents the most extreme case.

Here, in crop association, no single crop is particularly predominant. Most of the farms produce a little of everything within a greatly varied assortment of crops. These crops are completely for home use. In general, potatoes, wheat, rice, barley, millet, rape, beans, kaoliang, corn are the common crops on farms. This peculiar situation is conditioned by two factors, namely, the extremely dissected topography and the peculiarly friable rock structure. The dissected topography causes the extremely detached character of the settlement forms (consisting of isolated farmsteads perched on various hillocks), whereas the friable rock structure with numerous fall lines, makes the available river transportation very difficult. Therefore, these conditions make it even more difficult for farmers in this area to communicate with the outside world and thus accentuate their self-sufficient agricultural economy.

The soil condition of this area is also interesting. With the exception of a few narrow detached stretches of alluvial soils along the river banks, and some yellow earths at its northern periphery, the soils of this area is consisted of principally the unique "purple-brown" type of the Szechuan Basin (Fig. 9). In fact, the distribution of this fertile soil here is so uniform and continuous that this self-sufficient agricultural area of the northern Basin should be properly called the "genuine" purple-brown soil region of the whole Basin.¹

¹Chu, op. cit., p. 46.

Another interesting characteristic of this agricultural area of the northern Basin is that this area is the most important producing center of a very important semi-agricultural product, the herbs, in the Basin. In addition to the meager subsistent agricultural production, the herb furnishes as a very important "cash crop" for the farmers. This is mainly due to the fact that in this area there are large tracts of land where the slope is too steep and the soils are too shallow for regular crop production. These lands are used, either in cultivated form or in "wild growths" for herbs.

Other outstanding features of this agricultural area include its moderate population density (Fig. 10), its specially thick cypress growths, and the conspicuous absence of coal, iron, nanmu, and pine vegetations.

4. The Combined Agricultural and Forestry Area of the Eastern Basin

In terms of both the agricultural prosperity and the general appearance of its agricultural landscape, this combined agricultural-forestry area of the eastern Basin (Fig. 24) is the least attractive and poorest. Here the topography is dominated by the numerous steep high parallel anticlinal ridges. Plains and gentle hills are even more restricted.

As to soils, in addition to the usual "purple-brown" type of the Basin, there are numerous tracts of soils, old and young yellow earths, which are derived from limestone parental materials. In most cases these soils are shallower in depths than the purple-brown type and are much slower in the rate of renewal. These factors handicap considerably its efficient agricultural production.

The principal crops here are potatoes, hemp, rice, corn, wheat, and kaoliang. Although rice is reported to be grown in every district of this agricultural area, its acreage is more limited here than in any other agricultural area.

The agricultural land-use of this area is controlled largely by its topography. Agricultural lands here are derived from two principal sources, first, on the manger-like trough lands at the top of the broad anticlines wherever the bed rocks happen to be less resistant than the surrounding structures. These trough lands are, however, rather restricted in extensions.

Moreover, on account of the high ground water-tables here, the drainage conditions on these trough lands are very poor. These trough lands are sometimes used for wheat, hemp, rice, rape, or kaoliang, depending upon water conditions. But the productivity of these marginal agricultural lands are, in general, very low.

The second principal source of agricultural land-use here is developed on the more gentle slopes of the numerous synclines in this area. Here the slopes are terraced into rice, wheat, or potato fields. The drainage conditions are, in general, better than those in the trough lands of the anticlines. Considerable portions of the cultivated fields are used for Ta ma (hemp) and Tso Tsai (vegetable) cultures which are the two most spectacular agricultural products of this area.

The most outstanding feature of this agricultural area, as its name suggests, is the predominance of the forestry product, the tung oil. On the steep slopes or at the edge of the anticlines, where the soils are extremely shallow, great numbers of tung trees are planted. Especially during the past decade, stimulated by the increasing demand, the plantation of tung trees has been grown in leaps and bounds. This area alone now contributes about three-fourths of the total production of tung oil production of all the Basin. In one district, Ning-shui alone, it produces about 52 per cent of the total tung tree production of the Basin. This factor has increased greatly the population-support capacity for this agricultural area and also helps to explain the presence of a few detached high population density areas here (Fig. 10).

Another interesting characteristic of this agricultural area is that here lies about 65 per cent of the total coal reserve (Pa-hsien and Chiang-peh) and about 45 per cent of the total iron reserve (Chi-chiang and Nanchuan) of the whole Basin.¹ This remarkable fact suggests that in the future days to come, this agricultural area may abandon its present modest pursuits in agricultural and forestry production, and will soon take an unchallenged leadership in the growing industrial and manufacturing development of the Basin.

¹W. C. Chang, "The Iron and Coal Resources of Szechuan," Szechuan Monthly, V, No. 5 (1934), 35.

5. The Mixed Farming Area of the Southwestern Basin

Among all the principal agricultural regions of the Basin, the mixed farming area of the southwestern Basin (Fig. 24) is the most interesting. Here lies an area like a synthesis of all the above four areas. Besides its own unique quality, as we shall see shortly, this area possesses some characteristics of each and every one of the above four agricultural areas. This condition is true in topography, soil, crop association, and other aspects.

In topography, for instance, this area possesses some of the anticlinal ridges (but lesser in magnitude) like the eastern Basin; some irregular hills like the northern Basin; and some broad plains (in smaller extensions) like the Chengtu Plain, or rather, like the lower To-Fou valleys. However, unlike all the above four agricultural areas, the absolute relief here is, on the whole, the lowest, averaging about 300 meters above sea level.

In soil, this area is also a miniature model of the above four agricultural areas. The usual purple-brown soils of the northern Basin, the limestone soils (old and young yellow earths) of the eastern Basin, and the rich alluvial soils of the Chengtu Plain and To-Fou valleys are all present here (Fig. 9).

In agricultural land-use and crop association this area has the greatest variety of products. The broad river valleys of the Min (lower) and Yangtse furnish fertile fields for rice, sugar-cane, and orange groves. The more hilly lands, terraced in minute steps, are used for corn, wheat, rape, hemp, barley, potato, beans, and other crops. Unlike the other four areas, corn is the most predominant crop here. Moreover, on the steep slopes of the high anticlines, or on other more hilly areas, numerous forestry products, such as tung tree, tea, white wax, mulberry trees, and various kinds of bamboo, are found. Especially, the bamboo products and white wax are the most famous.

Above all, another interesting feature of this area is the bona fide tropical character of its agricultural and horticultural products here. Climatically, with the exception of the southeastern highlands of the Basin, this area is the warmest among all the agricultural areas of the Basin (Fig. 24). Such well known tropical products as Li Chi, Lun yen, bananas, and palm vegetation are found here.

Another special feature of this area is the difference in its water use. Like Chengtu Plain this area is endowed with

rich water supply by the Yangtse, the Min, and other rivers. Numerous channels are built here, for instance, such as the Wu Tung-chiao and Chien Wei districts. But contrary to the practice of Chengtu Plain, and for reasons unknown, very few of these channels are used for irrigation purposes. Instead, they are principally for transportation use.

Other interesting features of this agricultural area include its well-balanced endowment with mineral resources. Neither like the Chengtu Plain area of western Basin--where little or no mineral deposits are found--nor similar to the anticlinal areas of the eastern Basin--where is located the largest concentration of the Basin's mineral deposits, especially coal and iron--this area is rather well-balanced in various kinds of mineral deposits. In fact, this area is reasonably rich in every one of the strategic minerals, including salt, coal, iron, petroleum, copper, gold, and aluminum. Especially the salt production is the richest and the most important at present (Fig. 20).

In agricultural richness and productivity, this agricultural area of southwestern Basin, as a whole, compares favorably with that of the specialized commercial agricultural area of the lower To-Fou valleys. This fact is evidenced by the fine, well-kept farmsteads here (Fig. 34). In terms of population density, this area also stands out as one of the five high densely populated areas of the Basin (Fig. 10).

E. Agricultural Products

The Szechuanese commonly claim that anything which is produced on earth may be found in the Basin. At least it is safe to say that there is scarcely an article grown in China which is not produced here in abundance. First of all, the summer field crops include rice, corn, sugar-cane, tobacco, potato, millet, kaoliang, cotton, beans of all kinds, and a great variety of vegetables and fruits. The winter crops include principally wheat, rape, beans, peas, and many others.

1. Common Food Crops

a) Rice.--Rice (*oryza sativa*) is the master crop of the Basin. It normally occupies 43,000,000 mow, or 42 per cent of the

total cropped area.¹ With the exception only of Kuangtung province, Szechuan leads all China in rice production, and has a total annual output of between 140,000,000 and 180,000,000 piculs (one picul equals 133.4 pounds). Rice is produced on all the valley bottom lands and lower terraces in every district of the Basin where water supply is sufficient. There are three principal rice-producing areas, namely, the Chengtu Plain of western Szechuan Basin, the Sui-yung-Lu-hsien area of the southern Basin, and the Sui-ning-Tung-nan area of northwest Szechuan Basin.

In Chengtu Plain, with the exception only of Tsungching where no efficient irrigation water connections have yet been effected, nearly all the districts normally devote 80 per cent or more of their cultivated area to this king-crop--rice. In the other areas, which are more representative of average conditions in the Basin as a whole, the rice crop generally accounts for 25 to 40 per cent of the total cultivated area.

But whenever and wherever natural conditions (particularly water supply) permit, rice always has the right of way. In fact, the whole crop system of the Basin is so synchronized that rice always claims the first place. For instance, in the Chengtu Plain area, winter crops such as wheat and beans are often stripped of their foliage during the early spring in order to hasten their maturity so that rice may be planted in time.

Generally speaking, there are three principal varieties of rice planted in the Basin, namely, the irrigated, the upland, and the "double-growth" (Tsai Seng Tao) varieties. The irrigated variety, including the so-called early-mature and the later varieties, are the most important and are widespread throughout the Basin, whereas the cultivation of the upland variety is limited to the Shih-fang, Jen-shou, Hung-yao, and Kao-hsien areas.

The Tsai Seng Tao or "double-growth" variety, although confined now to only one district in Feng-chieh, almost at the eastern edge of the Basin, is an interesting crop. This variety has the unique characteristic of producing two crops yearly on the same plant. Like other rice plants, this variety is generally seeded in the last quarter of March, transplanted in the middle of May, and harvested for the first time in the latter part of August.

¹Report of the Bureau of Central Agricultural Research
(1939), p. 93.

After the first harvest, the land is tilled and refertilized, and the plant continues to grow until the middle of October, when a second harvest from the same plant may be made. The most surprising thing is that, as it is reported, this second crop often even supersedes the first in quality.

The cultivation of this Tsai-seng-tao variety of rice is one of the most efficient uses of land for rice-cultivation, particularly in those hilly areas where the so-called "tung-shui-tien" (winter-storing-water-field) system is practiced. Recently the Central Bureau of Agricultural Research, for the purpose of increasing land-use efficiency in rice-cultivation, launched a vigorous program for extending the cultivation of this variety in other areas of the Basin.¹

The maturing season of the rice crop varies between ninety and one hundred days, depending upon topography, climate, local agricultural practices, and the specific variety used. The seeding season may vary from the early part of March in the southern Basin to about the middle of April in the north. Consequently the harvest season follows the same trend, varying between the later part of July to the middle part of September. Here the operation of both the latitudinal and topographical influences is evident. Ordinarily, besides the aquatic habit, rice requires constant tillage, with repeated heavy manuring from time to time in order to secure a full crop. The plant usually occupies the ground from the latter part of May until early September.

One of the most serious problems in connection with agricultural land-use for rice culture, as already mentioned, is the practice of the so-called "Tung-shui-tien" system. Under this system the land is used for only four or five months during the year. This limited use is particularly unjustifiable in view of the favorable climatic conditions (the long growing season) and at the same time the urgent need for enough food to supply the millions of inhabitants. In the Basin there are over eight months which have an average temperature of 10 degrees C. (Table 3). Moreover, during the months of rice-growing period, the average monthly temperature is over 20 degrees C. (Table 3). Thus, climatically, there is every possibility for two crops of rice a

¹Chao, op. cit., p. 23.

year. Recently, the Central Bureau of Agricultural Research has been working feverishly to solve this problem.

It is interesting to note in this connection that contrary to the belief of many western agriculturalists and geographers, the age-old practice of rice-culture in Szechuan Basin, as in China as a whole, possesses many inherent virtues. First of all, not to mention the high yields the rice gives,¹ which are necessary to feed the millions, rice culture is the most effective means of preventing soil-erosion and conserving soil fertility. Moreover, since the rice fields are flooded during much of the growing season, rice cultivation has an important effect in checking floods. Third, wet-flooded rice-culture generally slows down the erosion of the soil, even more effectively than forest covering. On account of the topography of the Basin, this point is particularly significant. Finally, the abundance of water at times insures the land against becoming gummed up due to an excess of salts as in desert regions.

b) Corn.--With the exception of rice, corn or maize (*Zea Mays*) is the most important summer crop in the Basin. It usually occupies about 12,000,000 mow, or 12 per cent of the total cultivated area of the Basin. The Basin ranks first in all China in corn production, and normally has a total annual output of 32,000,000 piculs² (Fig. 35). Among all the crops in the Basin, corn is the most unusual and has a romantic story of considerable geographic interest.³ Like potatoes and tobacco, corn is of American origin and was introduced to China only during the last century by some Catholic priests during a serious famine in the Basin.⁴ Maize was raised on the hills near Wei-chao in 1857, less than one hundred years ago.⁵ It has now become one of the

¹With the exception of potatoes, the rice yield is the highest among all crops in China (cf. Buck, op. cit., p. 226).

²Bureau of Central Agricultural Research, Szechuan Provincial Government, Agricultural Statistics (Lung Ching Pao Kao, 1939), p. 94.

³It is interesting to note that corn, known by its Chinese name as "Yu Shu Chu," literally meaning the "jade grain from Shu" (the old name for Szechuan), was probably first introduced into Szechuan and later spread from there to other parts of China. This is evidenced by the Chinese name it now bears.

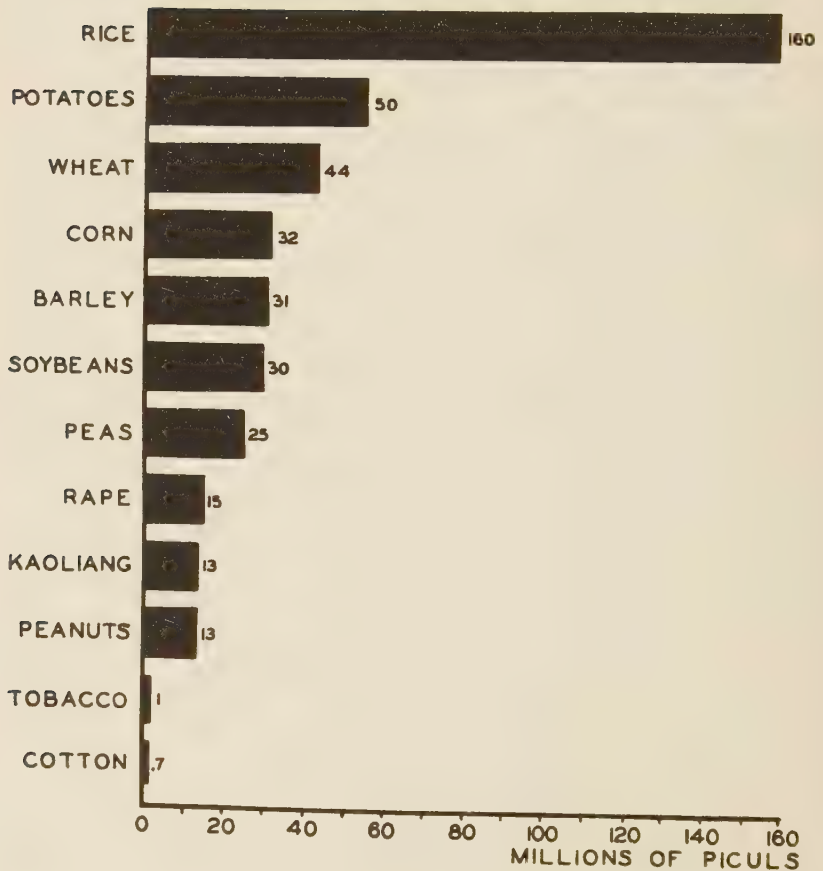
⁴Gazetteers of Szechuan, XXVI, 8.

⁵Gazetteers of Wei Cheo (1892 ed.), III, 28.

FIGURE 35

AGRICULTURAL PRODUCTION
SZECHUAN BASIN

1930 - 1935 AVERAGE



most important food crops, constituting 8 per cent of the total food supply for the population here, particularly in the northern and eastern parts of the Basin. Its juicy shoots are also widely used as feed for pig-rearing in the hilly areas northwest of Chengtu Plain.

Corn is the staple summer crop in the more hilly areas which do not hold reservoir water. It is also the principal crop in areas where swift streams debouch upon the plain and where the soils are too sandy to hold water for paddy. Moreover, wherever the slopes are too steep or the gullies too narrow, and the soils are too thin for other food crops, a few stands of corn are always found. Many times the slopes where the corn is planted are so steep that one wonders how the farmers ever manage to sow and reap the crop. With the exception of a few districts like Si-Chung and Yung-chang, which for reasons unknown produce very little corn, corn is cultivated in nearly every district of the Basin. This is particularly so in the southern peripheral areas of the Basin where several crops may be harvested yearly.

c) Potatoes.--The third most important summer crop of the Basin is the potato (*Solanum tuberosum*). It normally occupies about 6,000,000 mow, or about 6 per cent of the total crop area. On account of the high yield, the Basin leads all China in potato production, and has an annual output of 56,000,000 piculs (Fig. 35). Potatoes, like corn, are also of American origin and were introduced into the Basin only about seventy years ago.¹ They are now universally cultivated throughout the Basin, especially on the upper hill terraces. More than any other province in China (with the possible exception of Kwangtung), potatoes here serve as a very important source of human food, constituting about 9 per cent of the total food supply, particularly in the northwestern and southern hilly areas of the Basin. Sometimes they are also used as feed for pigs. It is reported that on account of the extraordinarily high starch content in the potatoes produced here, an increasing portion of the crop is being used in the manufacture of alcohol and other fuel supplies for war-use during recent years.

d) Kaoliang and other summer crops.--The other important common summer food crops in the Basin include kaoliang (*Sorghum Vulgare*) and a great variety of soy beans (*Glycine hispida*). Each

¹Gazetteers of Ping Shan, I, 8.

occupies about 4,000,000 mow, or 4 per cent of the total crop land. Kaoliang, sometimes called false millet, is a staple dry crop on hilly lands. It is noted for its special capacity to be without water for a long time (longer than corn) without drying to death. The choice of these two crops by farmers for a certain area often depends on this point. Besides being used widely for human consumption, as well as for livestock feed, kaoliang is used mainly (between 70 and 80 per cent of the total crop) for the manufacture of wine, the famous kaoliang wine. This last use proves to be particularly advantageous to the farmers because wine can be transported to far distant markets when the sale of bulky grains, owing to prohibitive transportation costs, is difficult.

e) Wheat.--The most important winter food crop is wheat (*Triticum Sativum*). It normally occupies about 15,000,000 mow, or 17 per cent of the total crop area, and the Basin has an annual output of 44,000,000 piculs (Fig. 35). The Basin is the fifth largest wheat producer in all China. With the exception of the Chien-chiang district (which for reasons unknown does not produce wheat), wheat is produced as a winter food crop in nearly all parts of the Basin, particularly in the districts around Chengtu Plain. The wheat prefers the more clayey soils of the Basin, and gives a particularly good yield.

The crop matures generally in 150 to 170 days. In most parts of the Basin, the field is seeded in the middle of October and the harvest takes place in the early part of May, depending upon the latitudinal position, as well as the topography of the area. Next to rice, wheat is the most important food crop of the Basin, contributing 12 per cent of the total food supply. It is eaten in the form of "mien" (noodles) or in other forms of dumplings.

f) Rape seed.--The Basin leads all China, both in area and in total annual production of rape (*Brassica juncea*; a winter crop). Normally it occupies an area of 11,000,000 mow, or about 10 per cent of the total crop area, and the annual output is 15,000,000 piculs¹ (Fig. 35). From the rape seed, oil is extracted for cooking and many other purposes. The seed cakes also furnish

¹Bureau of Central Agricultural Research, Agricultural Statistics (1939), p. 97.

a very important source of fertilizer. It is the most important source of vegetable oil supply of the Basin. Recently, research projects have been launched by the Central Chemical Research Bureau of China to study the possibility of using rape-seed oil for manufacturing synthetic petroleum and other motor oils for war use.

g) Barley and other winter crops.--Other important winter crops in the Basin include barley (*Hordeum vulgare*), buckwheat (*Polygonum fagopyrum*), and a great number of species of peas (*Pisum Sativum*). Barley normally occupies about 12,000,000 mow, or 11 per cent of the total crop area. Second in all China, the Basin's annual total output of barley normally amounts to 31,000,000 piculs (Fig. 35). Barley, like buckwheat, is an important dry winter crop on hilly lands in the northern part of the Basin. These crops generally do not require heavy soil, and call for little fertilization. The total acreage in various kinds of peas and beans is usually about 10,000,000 mow, or about 9 per cent of the total crop area. They grow both on hilly and plain areas throughout the Basin. But in plain areas they are used mainly for inter-culture purposes, with wheat and other crops.

2. Special Agricultural Products

a) Cotton.--China's "cotton-belt" lies north of the Yangtse. South of the Yangtse, comparatively little cotton is produced. Geographically, Szechuan Basin lies in a southernmost position among all the provinces north of the Yangtse and is therefore in an intermediate position so far as cotton production is concerned (Fig. 1). The most important cotton producing districts in the Basin lie between latitude 29 degrees and 32 degrees N. Particularly the heaviest concentration is at 31 degrees N., around the districts of the upper Fou River Valley, such as Suining, Shei-hung, Santai, Chung-chiang, and Yen-ting (Fig. 36). These five districts accounted for nearly 60 per cent of the total crop in 1936 (Table 4).

In these areas the total annual rainfall generally runs below 1,000 millimeters (Fig. 24). Most of the rain falls during the summer, but there is also considerable rainfall in the early autumn (Table 5). This distribution of rainfall, as we shall see later, is not very satisfactory for cotton production. The soil conditions, however, are quite favorable for cotton production.

The soils are mainly alluvial, on flattish valley-bottom lands. In these districts the cotton acreage sometimes occupies as much as 70 per cent of the total crop area. Most of the cotton produced here consists of a number of American varieties (Delfos, Trice, etc.).

The second principal cotton-producing area is found in the hills of the lower To River Valley, in the districts of Chien-yang, Yung-hsien, and Wei-yuan (Fig. 36), where the native varieties are dominant.

The third cotton-producing area is along the hilly slope lands of the lower Min River, in the districts of Jen-shou and Ching-yen (Fig. 36), where native cotton is the principal variety.

The fourth cotton-producing area is in the lower Chialing River Valley, particularly in Nan-pu, Pa-chung, and I-lung.

The total acreage in cotton in the Basin is generally estimated to be about 2,200,000 mow. The total annual output is about 600,000 piculs,¹ (Table 4), which falls far short of the need of the Basin. (It is estimated that the Basin requires 1,500,000 piculs of cotton annually, averaging 3 ching of cotton per person.) This shortage accounts for the ever-increasing import of cotton yarns and cotton piece goods by the Basin every year. The cotton shortage now constitutes one of the most serious problems of the Basin's agricultural land-use.

There are four reasons for this failure to produce enough cotton for the needs of the Basin. First of all, climatically, the high rainfall in many parts of the Basin, during the autumn months of September and October, generally hinders the maturity of the cotton bolls and induces serious insect pests. According to the record of the meteorological station at Sui-ning,² the mean annual temperature is 17.9 degrees C. (64°F.), the absolute minimum during the year is 2.2 degrees C. (39.6°F.), and the maximum absolute during the year is 37.7 degrees C. (98°F.). The average annual rainfall is 929 millimeters. January has a minimum rainfall of 4.7 millimeters, while August has the high maximum rainfall of 227 millimeters (Table 5).

¹The 1936 production falls far short of this figure due to the serious drought of that year.

²Annual Meteorological Report of Sui-ning Station (1937), pp. 38-39.

Generally speaking, the total annual rainfall here is sufficient for cotton production. But the fact that so much of it (about 22 per cent of the total annual rainfall) falls during the months of September and October (Table 5), with an average of only five clear days during this period (Table 5), is particularly detrimental to cotton production, especially to the maturing of the cotton bolls. It is reported that as much as 50 per cent of the cotton bolls are often destroyed by this heavy rain. Thus the problem of extending cotton production in the Basin lies not so much in the limitations of the soil as in the limitations of the climate, particularly of the rainfall regime.

One of the methods to be adopted to overcome this climatic limitation upon cotton production is to select early-maturing species of cotton. Since the temperature during April in most parts of the Basin is already high enough for cotton and if the cotton plant can be planted at this time (instead of in June, as is the usual practice here), the crop may be harvested early, before the heavy autumn rains set in. On the whole, so far as the climatic conditions are concerned, the northern part of the Basin is more suitable for cotton production than the southern part.

The second reason for the failure to produce enough cotton in the Szechuan Basin is that the sandstone soils, which prevail in most parts of the Basin, are considered unsuitable for the cultivation of cotton. Cotton-production is consequently limited chiefly to small alluvial areas or to the hilly sections, where the soils are generally too thin and infertile for cotton production.¹

Third, the cotton is planted relatively late in the year. Cotton is a summer crop here, and is generally planted after the harvest of the winter crops, which may be either wheat or barley. This practice seems to be a little late for the cotton plant, and is particularly unsatisfactory in the case of the imported American variety. The late planting thus hampers growth and production.

Fourth, the heterogeneity and the inferior quality of the native strains of cotton have hampered greatly its successful production. And finally, the traditional practice of inter-culture

¹Hou, "Notes on the Cotton Soils on Sui-ning Area, Szechuan," Soil Quarterly, I, No. 3 (January, 1941), 6.

of cotton with other crops, such as corn, soy beans, potatoes, pepper, and others, has been found especially undesirable. The inter-culture with corn is particularly disastrous to the cotton, because the corn has heavy foliage and competes keenly with the cotton plant for sunlight and moisture. All these factors, whether individually or in combination, have contributed to the failure of cotton culture in the Basin.

Recently, on account of the pressing need for increasing clothing materials, the Bureau of Central Agricultural Research has undertaken rigorous projects to improve the unhappy situation. By the beginning of 1940 the Bureau had extended the cotton promotion program over fifty-seven districts of the Basin, with particular emphasis on the cultivation of imported varieties, such as Delfos, Trice, and some improved local strains. Some of these varieties possess the special virtue of maturing early, before the autumn rains set in and injure the bolls. Cotton control stations have been established in a number of key points (such as Sui-ning, Shei-hung, and Santai) in order to avoid hybridization and to preserve the purity of the improved strains.¹ Moreover, special measures have been taken to discourage the old practice of inter-culture in cotton planting.

b) Tobacco.--Tobacco (*Nicotiana tobocum*), or "Yen," as the Chinese call it, like corn and potatoes, is another plant which had its origin in the New World. It was transplanted to China around 1540 and was first cultivated in the Basin about 1750.² The Basin normally produces about one-fourth (an average of 1,500,000 piculs) of all the tobacco produced in China.³ It is reported that tobacco is produced in fifty-seven districts of the Basin. The principal producing areas are in Chengtu Plain, and there are special concentrations in the districts of Shih-fang, Pi-hsien, Sin-tu, and Ching-tang (Fig. 37). Other important producing centers include Mei Shan in the south, and Mien-chu in the north at the edge of the Chengtu Plain. The Chengtu Plain area generally accounts for about 60 per cent of the total production of tobacco in the Basin (Table 6).

¹Report of the Bureau of Central Agricultural Research (1939), p. 86.

²Gazetteers of Pi-hsien, III, 4.

³The production figure for 1936 (Table 6) is lower than that for other years due to a serious drought that year.

Generally speaking, the principal tobacco-producing areas lie between 29 and 32 degrees North latitude (Fig. 37). In these areas the average temperature for the coldest month (January) ranges between 5.8 degrees C. (43°F.)--at Wen-chiang--in the north, and 12.7 degrees C. (55°F.)--at Mei Shan--in the south. The lowest temperature ever recorded is about 2 degrees C. (36°F.). The rainfall throughout the growing season is sufficient (over 40 inches yearly), and the average relative humidity throughout the year is between 75 and 80 per cent¹ (Table 8). These climatic conditions are considered favorable for tobacco growth.

Moreover, the unfailing supply of irrigation water from the Tu-chiang-yen Works has insured even further the sufficiency of the water supply for tobacco production. The soil conditions are also favorable. The soils range from clay loam to loose sandy loam of sufficient depth. In spite of the high relative fertility of these soils, the tobacco fields in Chengtu Plain require heavy fertilization. The application of "lu-tiao" (*Astragalus sinensis*) as green manure, plowed under during the early spring, is most common.

Tobacco is usually a spring crop within the rice-belt of Chengtu Plain. The seeds are sown in late October and the crop harvested by mid-June. This practice usually delays the seeding-season of rice by two or three weeks (as rice is a summer crop here, following immediately after the tobacco). Consequently, both the yield and the quality of the rice crop are often reduced, the yield sometimes by as much as 20 to 30 per cent. This conflict between tobacco and rice constitutes one of the most serious problems of the tobacco- and rice-producing areas here. Recently, the local Agricultural Experimental Station conducted a number of experiments with a view to selecting an early-maturing variety of tobacco so that it might not hamper the growth of the rice. There is an old saying among the peasants here: "Shih nien tsao, chiu nien hao," literally meaning, "ten years early, nine years prosperous." This vividly expresses the need for an early-maturing variety of tobacco.

On account of the heavy drain which the tobacco crop exerts on soil fertility, rotation systems, commonly with corn, soy beans,

¹Bureau of Reconstruction, Szechuan Provincial Government, Meteorological Report (1938).

or peanuts, are practiced in most tobacco-growing areas. Only in the districts of Sin-tu and Shih-fang, in the heart of Chengtu Plain, where soil conditions are especially fertile, has tobacco-cultivation been carried on from year to year without rotation.

The best tobacco leaves are produced in the Shih-fang and Sin-tu districts. They are fine in quality, fragrant in flavor, and are almost ideal for making cigars and cigarettes. The poorest products come from Mien-Chu and Te-yang. Besides supplying the local demand, tobacco leaves and products find their markets in Shensi, Kansu, Yunnan, and Kweichow provinces, and even as far away as parts of Central Asia and Russian Turkestan.

c) Sugar cane.--The method of refining sugar from sugar cane was first imported into China from India during the early part of the Tang dynasty (618-906 A.D.). As early as the reign of Emperor Tai Tsung of Tang dynasty, there was a monk named Tsou, who initiated sugar cane cultivation in the Nan-chung district of the north central Basin.¹ Since then, the production of sugar cane (*Saccharum officinarum*) has been steadily developed into a very important agricultural enterprise, particularly around the To River Valley.

The sugar-cane crop thrives well only in a warm, humid climate, ranging from tropical to sub-tropical. During its growing season, the average temperature must be around 20 degrees C. (68°F.), and the average annual rainfall about 1,500 millimeters. At the time of maturity, the temperature must be relatively cool, and the humidity must be low.² In most areas of the Basin where sugar cane is produced, the local climatic conditions fall short of these requirements. Instead of having an average annual temperature of 30 degrees C. (86°F.) or 25 degrees C. (77°F.), as in Java and Cuba, respectively, where the most important sugar-cane producing areas of the world are located, the maximum annual average temperature of the Basin is only 17.9 degrees C. (68°F.) (Fig. 24). This temperature is far too low for satisfactory sugar-cane growth. Even compared with the other sugar-cane growing areas in China, such as Kwangtung and Fukien provinces,

¹Gazetteers of Nanchung District, IV, 6.

²Y. C. Chen, "A Discussion on Improved Methods for Cultivation of Sugar-cane in Szechuan Province," Szechuan Reconstruction Monthly, IV, No. 8 (1933), 29.

Szechuan Basin has a much shorter summer season and a lower minimum winter temperature.¹

As a result of this climatic limitation, it is impossible for sugar cane in the Basin to flower. This fact, of course, eliminates at once the possibility of bi-sexual breeding. All the native varieties are therefore produced by asexual reproduction. The tips of the sugar cane crop are cut down in the winter and are buried underground. When spring comes, these shoots are planted. This practice handicaps seriously any attempt to improve the breed. Moreover, while sugar cane in Java and Cuba may continue to grow and produce for two and three years or more, such growth is impossible here in the Basin. The lack of irrigation facilities in most of the sugar-cane fields in the hilly areas has further handicapped its successful growth.

Sugar cane generally thrives better on sandy loam soils (Fig. 38) than on clay loams. In the Basin it is, however, planted on both types of soil. It is reported by farmers of these areas that sugar cane grown in the more hilly areas, where the loose, sandy loams predominate, has a much higher sugar content than that grown on the "Pa-ti," or alluvial plains, where clay loam is the chief soil type. Thus, about two-thirds of all the hilly lands of Tze-chow and Nei-chiang are devoted to sugar cane. However, because good irrigation facilities are lacking in many parts of these hilly areas, many sugar-cane fields suffer serious droughts when natural rainfall falls short.

Rotation systems are commonly adopted by sugar cane growers. The most common practice is yearly alternation of sugar cane with corn, kaoliang, or peanuts. Sugar cane is generally a summer crop. During the winter season, sugar cane fields may be used for wheat, rape, or peas, or may be left to lie fallow.

Although sugar cane is reported to be grown in forty-four districts throughout the Basin (Table 7), the principal producing

¹The average temperature of May-September for Canton is above 26 degrees C. (79°F.); for Amoy (Fukien), June-September is above 26 degrees C. (79°F.); but for Chungking, the average temperature for the period between only July and August is above 26 degrees C. (79°F.), whereas for the period of May-September is only 25.8 degrees C. This, of course, means a shorter summer, at Chungking. Moreover, the winter minimum for Canton (January) is 13.1 degrees C. (55.6°F.); for Amoy (January) 12.2 degrees C. (54°F.); and for Chungking (January) only 8.8 degrees C. (47.8°F.) (cf. Annual Report of the Central Meteorological Bureau [1934], p. 32).

areas are concentrated mainly in five districts of the To River Valley, namely, Nei-chiang, Tze-chung, Tze-yang, Chien-yang, and Fu-shun (Fig. 37). In 1936 these five districts alone accounted for 73 per cent of the total crop (Table 7).

There are two principal kinds of sugar cane produced here, namely, the red cane and the white cane. The red cane is used for chewing purposes, whereas the white is used mainly for sugar-extraction. Unfortunately, because of the poor quality of the cane and the inefficient methods of refining, the local sugar production is not only small in quantity (pure sugar production only about 1,000,000 catties), but also poor in quality. Consequently, in the face of keen competition from high-quality imported sugar, the sugar produced in the Basin (with the exception of Chieh-tang sugar, a specially treated medicinal sugar which normally finds its principal markets in the I-chang and Hankow areas) has been driven out of the former inter-provincial markets, such as Yunnan and Kweichow. Moreover, the local sugar cannot even maintain its foothold in the local market. This fact is evidenced by the increasing import of foreign sugar into the Basin.

Sugar cane and cotton constitute two of the most acute problems in agricultural land-use in the Basin. Recently, various programs have been launched by the Bureau of Central Agricultural Research in order to improve this situation. Sugar cane improvement stations have been established in the Nei-Chiang, Tze-yang, and Chien-yang districts. A large number of foreign species have been transplanted from Java and Cuba. It was recently discovered that the species P.O.J. 2878 and P.O.J. 2725, selected from Java breeds, adapt specially well to local environmental conditions in the Basin. They have a 5 per cent higher sugar content than most of the native species. Rigorous attempts are being made to extend these two species among the Basin farmers.¹

d) Hemp.--The two principal species of hemp produced in the Szechuan Basin, namely, the "chu-ma" (*Corchorus capsularies*) (or ramie, China grass, as it is popularly known in the west), and "hou-ma" (*Cannabis sativa*), or fire-hemp, as it is called locally. These two species, being produced in different areas with widely different physical requirements, are used for entirely different purposes. The "chu-ma" is further divided into two kinds--the

¹Chen, op. cit., p. 22.

green and the white. The producing areas of green chu-ma are confined mainly to the districts of Ta-hsien, Chu-hsien, Ta-chu, Peng-an, and Pa-chung, in the Chu River Valley in the eastern part of the Basin, and to the districts of Peng-shui and Pei-ling in the southern part of the Basin (Fig. 36). The white chu-ma is produced mainly in the Nei-chiang, Lung-chang, and Yung-chang districts, where it is noted for its fine quality. The total production of the two kinds of chu-ma amounts to 40,000 piculs annually. The "hou-ma" is produced principally in the districts of Wen-chiang, Pi-hsien, Shuan-liu, and Tsung-ching, west of the Chengtu Plain (Fig. 36). The total production is a little over 100,000 piculs annually.

The Chu-ma hemp survives especially well on the sandy loams of well-drained slopes, whereas the "hou-ma" hemp is produced in plain areas. Both species require a warm, humid climate and protection from wind during the growing season. They also demand a clear, dry season during the time when the fiber matures. In the heart of the "hou-ma" hemp-growing area around Chengtu Plain, in the districts of Pi-hsien, Wen-chiang, and Shuan-liu, for example, the average January and February temperatures lie between 5 and 10 degrees C. (Table 9), and the lowest minimum temperature during these two months seldom falls below 2 degrees C. (36° F.). From March through June, i.e., during the period of growth and maturity, the average temperature of these districts gradually increases, ranging between 12 and 26 degrees C. (54° and 79° F.). The relative humidity between January and June is always above the 70-per-cent mark¹ (Table 9). These climatic conditions are especially favorable for the hemp plant.

However, the rainfall in April and May, usually between 10 and 20 centimeters, seems to be a little low for the growing season.² In Wen Chiang, for example, the rainfall for these two months is only a little over 10 centimeters, and the rainfall at Pi-hsien for the same months is only slightly over 17 centimeters (Table 9). Fortunately, this scarcity of rainfall is remedied by

¹Bureau of Reconstruction, Szechuan Provincial Government, Report of the Meteorological Bureau (1939), p. 19. (Unfortunately, many stations here do not have complete records for all months, thus rendering the interpretation more difficult.)

²Ibid., p. 21.

the water-supply of the nearby Tu-chiang-yen irrigation works. Hou-ma hemp is a spring crop. The seeds are sown in February, and the plants harvested in the middle of June, just as soon as they commence to flower. The stems are allowed to grow close together, and to reach eight feet or more in height. The culms are reaped, stripped of their leaves.

One of the most interesting practices in connection with Hou-ma hemp culture in these areas is the extremely intensive cultivation of the soil-beds. There is an old saying among the Hou-ma farmers, "Till nine times for hemp." This cultivation is necessary mainly because the roots of the young hemp plant, which are especially tender and weak, may be hampered in their proper growth if the soil bed is heavy. The use of "lu-tiao" (*Astragalus sinensis*) as green manure is also quite common here.

With the exception only of the Wen-chiang district, rotation with rape or wheat is commonly practiced by the hou-ma farmers of Chengtu Plain.

The uses and markets of hou-ma and chu-ma are just as different as their methods of culture and their physical requirements. In the case of chu-ma hemp, the white variety is used in the manufacture of the famous "hsia-pu," or summer cloth, which is well known over all parts of China, as well as in Korea and Japan. It has a particularly wide market in Hopeh, Shensi, Shangtung Honan, and Kwangtung provinces. It has also been shipped in considerable quantity to Korea and Japan. The green chu-ma hemp is all exported in the raw form to Japan and to France, for the manufacture of artificial silk. The hou-ma is used principally for rope-making, cordages, grain sacks, salt-bags, and military sacks. These products have their chief markets within the Basin, particularly in the salt-producing areas of Tze-liu-ching.

3. Special Agricultural and Horticultural Products

a) Citrus fruits.--Among all the sub-tropical products in the Basin, citrus fruits, especially oranges, have the widest range in geographical distribution. From Ching-Tang at the north to as far as Chiang-tsin at the south, nearly all the districts south of latitude 31 degrees N. produce citrus fruits. The most important centers of citrus fruit production are, however, confined to a few districts, namely, the Ho-chuan of the middle Chialing River, Chiang-tsin and Pa-hsien along the Yangtse,

Ching-tang, Chien-yang, Tze-chung, and Nei-chiang of the upper and lower To River Valley, and Chang-shou and Wan-hsien in the east of the Basin (Fig. 36). These few districts generally account for over 80 per cent of the total crop (Table 10). The production of grapefruit is concentrated in the districts of Liang-shan, Chang-shou, and Feng-chieh. The total acreage in citrus fruit cultivation is generally estimated to be approximately 70,000 mow (Table 10), with 1,600,000 trees and a total production of some 200,000,000 fruits.¹

Of all the tropical plants grown in the Basin, the introduction and cultivation of citrus fruits has the earliest history. As early as the Chin dynasty (265-419 A.D.), citrus fruits were reported grown here.² Later, at the end of the Ming dynasty (1368-1644 A.D.), after the wholesale massacre of the original population of the Basin by the rebels Chang and Li, and with the influx of large numbers of immigrants from the tropical provinces of Kwangtung and Fukien, a great number of new species of citrus fruits were brought in, and the acreage was greatly extended.

Two of the most serious problems in citrus fruit production here are the relatively high perishability of the local fruit and the absence of quick and efficient transportation facilities. It is reported that sometimes as high as 25 to 40 per cent of the total crop has been spoiled before the fruit could be shipped to distant markets. This is particularly true with the "hung-chu" or red oranges (*citrus aurantium*), which comprises about 85 per cent of the total citrus fruit crop. The "huang-ko," yellow peeled oranges and grapefruits, which comprise only 15 per cent of the total crop, are less perishable, and can better withstand long distance hauling. In general, the farmers have to sell the fruit as fast as it is picked. Normally this means that they have to sell it cheaply. For example, at Chungking, during the picking season, one can buy as many as 200 oranges for only one silver dollar, whereas at Hankow, approximately 650 miles away, the same dollar will purchase only 8 or 9 pieces of the imported oranges! This difference in price is certainly astonishing.

¹C. L. Chung, "Some Problems Regarding the Cultivation of Citrus Fruits in Szechuan Basin," Szechuan Reconstruction Weekly, III, No. 7 (1932), 16.

²Hua Yang Kuo Chih (Gazetteers of Hua-yang). Chuan 2, p. 8.

At present, the farthest markets to which the citrus fruit of the Basin can be safely and profitably shipped are at I-chang and Sha-shih, which are only about four hundred miles away.

The difficulties of marketing the fresh "hung-chu" red oranges are so great that many farmers find it more to their advantage to let the fruit rot in the fields and to sell the orange peel for medicinal purposes. The difficulty of marketing hand-caps seriously the agricultural economy of these orange-producing areas. Recently, the Szechuan Provincial Agricultural Experimental Station established several breeding stations in Chiang-tsin and Ho-chuan, with a view to selecting breeds of the less perishable species of "huang-ko" or yellow oranges. At the same time, various canning plants have been recently established in the producing areas to manufacture canned orange juice and other canned fruit products. Both of these measures will undoubtedly help to relieve the grave situation.

b) Tea.--Tea (*Camellia thea*) is recorded to have been cultivated in Szechuan Basin during the Early Han dynasty (202 B.C. to 25 A.D.).¹ However, it did not become a common beverage among all classes in the Basin until the sixth and seventh centuries.² There are now some forty districts in the Basin reported to be producing tea of one kind or another (Table 11). The three principal tea-producing areas of the Basin (Fig. 37) are the western area, including Pei-chuan, Kuan-hsien, Ta-I, and Tsung-nai; the eastern area, including the Wan-yuan, Kei-chiang, and Cheng-ko districts; and the southern area, including Ho-chiang, Yun-nien, and Ping-shan. Among these, the western area is by far the most important in both the quantity and the quality of the tea produced. The total tea acreage is normally about 300,000 mow, and has an annual output of about 120,000 piculs (Table 11).³

¹Quoted by an article entitled "The Production and Market of Tea at Kuan-hsien Area," Szechuan Econ. Monthly, VIII, No. 3 (1937), 87.

²A cup of tea in China, taken not primarily to assuage thirst, is a thing to play with, to set before a guest, and to talk over. The tea house, a unique Chinese institution, which is found in Szechuan Basin perhaps more than in any other province of China, is much more than a club. It is a meeting place where business talks are generally carried on, rumors are spread, and gossip about one's friends is tossed about. The tea house is a vital factor in the social and cultural life here.

³Bureau of Agricultural Research, "Statistics on the Production of Tea," Szechuan Economic Monthly, VIII, No. 1 (1936), 58.

As in many other parts of China, tea cultivation here is primarily a by-profession of farmers, and very few large plantations are found. It is reported that there are more than 35,000 farming families engaged in producing tea.

Perhaps nowhere else in China has tea been produced in so many grades and prepared in so many forms as here in the Basin. The grades range from the most handsomely packed silver-needle green tea of finest aroma to the most roughly-wrapped ugly-looking brick tea. This range is made available in order to meet the varied demands of widely different markets. The most important export tea markets of the Basin are the regions of Tibet, Sikang, and Kokonor. The Basin supplies nearly all the demand of these areas, which normally totals more than six million dollars per year.

Nevertheless, this small but profitable trade may soon be denied to the Basin. It is greatly feared that keen Indian competition is growing and threatening the Basin's export tea trade to Tibet. In fact, the competition of Indian tea even now extends from Tibet to the Sikang markets. Geographically, the Indian tea is in a more favorable position to compete for the Tibetan tea market than tea from the Basin. For example, from Darjeeling to Lhasa it is only about 350 miles, while from Kan-ting (Tachien-lu), the principal collecting point of the Basin's tea on its way to Tibet, to Lhasa is twice that distance (nearly 700 miles) and requires sometimes two months' journey. Moreover, the physical difficulties of transportation in the Basin are also greater. This favorable geographic position of India is further evidenced by the fact that a considerable portion of the herbs from the Tibetan highlands are now being exported through the Darjeeling route.

The tea for the export markets comes largely from the western and southern producing areas. Normally Kuan-hsien is the collection-point and Sung-pang the distribution point of all tea from the western producing areas, whereas Yaan and Kan-ting (Tachien-lu) serve in the same capacity for the southern producing areas. The tea for these distant markets is generally wrapped in 60-pound or 80-pound packages and is transported principally on men's backs.

c) Medicinal herbs.--Szechuan Basin has long been noted in China, in fact in the whole Far East, for its production of a

great variety of vegetable drugs. There are six principal producing areas in the Basin (Fig. 37): (1) the western area, including Sung-pang, Li-fang, Miao-hsien, and Wen-chuan, with Kuan-hsien as the chief collecting and distributing center; (2) the southern area, including I-ping, Ching-fu, Kao-hsien, and Yun-nien, with I-ping as the trading center; (3) the southwest area, including Lo-shan and Chien-wei, with Yaan as the trading center; (4) the northern area, including Chiang-yu, Ping-wu, and An-hsien, with Chung-pa as the trading center; (5) the districts of the Chialing River area, with Ho-chuan as the trading center; herbs from southern Shensi and Kansu also pass through Ho-chuan; and (6) the eastern area, consisting of Kai-hsien, Fu-hsi, Feng-chieh, Kai-chiang, and Liang-shan districts.

Of these six principal herb-producing areas, the western area is by far the most important. It generally accounts for one-third of the Basin's total production. The medicinal herbs are found in the hilly and more mountainous areas in the Basin, and grow under a great variety of climatic and soil conditions. But, as a rule, the herbs especially thrive well on the more rugged mountain slopes and in the cooler climates.

It is reported that as many as two hundred or more different kinds of herbs (including both cultivated and wild species) are produced in the Basin and its surrounding areas.¹ And seventy-nine of them are prominent in inter-provincial and export trade. Many have been of high value to the Chinese for ages. Recently, some of them have been used extensively even by western peoples, particularly the well-known ma-huang (ephedrine), licorice, Ta-huang (medicinal rhubarb), Huang-nien (*coptis chinensis*), and many others.

One of the most serious problems in herb production in the Basin is that of bringing more of the valuable wild herbs under cultivation so as to stabilize the production and bring down its costs. It is reported that many formerly valuable wild species of herbs, as a result of human disturbances and reckless exploitation, are now nearly extinct.²

¹T. H. Cheng, "The Herb as an Important Product of Szechuan," Chinese Science Monthly, XVIII, No. 1 (1932), 28-32.

²Ibid., p. 30.

Prior to the Republic (1912) the export of medicinal herbs, together with silk and tung-oil, formed the backbone of the export trade of the Basin. Herbs alone generally accounted for between 15 and 20 million dollars yearly. But recently, on account of the constant warfare and heavy taxation, as well as the increasing competition of western drugs, the herb trade has reached a low point; in 1936 the total value of herbs exported amounted only to some 7 million dollars.

Chungking is normally the biggest center for transshipment of herbs to outside markets. It is not only the point of convergence of the herb products of the six main producing areas, but also herbs from northern Kweichow and southern Shensi (by the Chialing and Chi waterways, respectively), are shipped via Chungking, on their way to lower Yangtse markets. Thus, for a long time, Chungking has been known as the "jackpot" of the herb trade of the Far East. The principal domestic markets for the Basin's herbs include Kiangsu, Chekiang, Kwang-tung, Honan, Hunan, and Hupeh provinces, whereas the chief foreign buyers are Japan, French Indo-China, and France.

d) Cho Tsai or pickled (fermented) vegetable.--Cho Tsai, or pickled vegetable, is another unique product of Szechuan Basin, which is the only region in China where this food is produced. Cho Tsai has long been regarded as a great delicacy and a tasty seasoning for cooking in various parts of China, particularly in the lower Yangtse Valley and the North China Plain, as well as in Japan and countries of the South Sea Islands. Large quantities of this delicacy (some two or three million dollars' worth) are exported yearly to these areas from the Basin.

The principal producing areas of Cho Tsai are in the east of the Basin, particularly in Pei-Ling, Feng-tu, Chang-shou, Chiang-peh, and Pa-hsien districts (Fig. 37). The products from Pei-Ling and Lo-Chih (Chiang-peh) are especially famous.

This vegetable, locally known as Ching Tsai, being a species of chard, thrives well in a wide range of soil conditions. It requires good drainage. The plant is ordinarily seeded in September after the reaping of the summer crops; and the harvest takes place some time around January or February. During its growing season it requires a humid, mild climate. In many localities it forms a very satisfactory rotation crop with rice.

The process of preparing Cho Tsai is interesting. It is dried (by solar radiation), specially treated with salt and other ingredients (somewhat fermented), seasoned with pepper, and packed in air-tight tanks for export. Like Sunkist oranges from California in the United States, this unique product, "Szechuan Cho Tsai," has been for years the best advertisement for the name of "Szechuan" in many parts of the Far East.

4. Livestock Production and Special Animal Products

This term, livestock production or animal husbandry, has a special meaning as used in oriental agriculture. Livestock production here in the Basin, like in many other parts of China, is concerned only with the quick-growing food stock, the species that are easily cared for and do not require special feed. These normally include pigs, chickens, ducks, and some geese. While some cattle and sheep are raised here, they are seldom used for dairy products as in the West.

According to the recent report of the Bureau of Central Agricultural Research, for every one hundred farming families in Szechuan Basin there are 40 water buffalos, 17 head of cattle, 2 horses, 39 goats, 2 sheep, 169 pigs, 366 chickens, 149 ducks, and 20 geese.¹

a) Bristles.--In the western commercial world, bristles, like silk and tea, during the past years has always been associated with China. The principal producer of this well known Chinese product is Szechuan Basin. Normally the Basin supplies about one-fourth of the total export of all Chinese bristles, including 15,000 piculs of black and 4,000 piculs of white bristles. Among all the outstanding exports from the Basin, bristles is the only one that has always maintained a predominant position. It now alone comprises about one-fourth of the total value of the export trade of the Basin.²

¹Report of the Bureau of Central Agricultural Research (1939), p. 42.

²The export of bristles has jumped from eighth to fourth place in China's foreign trade since 1939, next only to raw silk, egg products, and tungsten. Szechuan Basin has been the largest producer, contributing about 40 per cent of the total export of this product (cf. J. H. Huang, "An Analysis of Foreign Trade of Bristles of Szechuan," Journal of Foreign Trade, March, 1941).

Pig-raising is a common side-line of all farms in the Basin. Bristles are produced in nearly every district of the Basin. But the most important producing centers are I-ping, Pa-hsien, Nan-chung, Chien-yang, Yung-chang, and Lung-chang (Fig. 39). Most of these districts produce black bristles. Yung-chang and Lung-chang alone are noted for their excellent white bristles. They are particularly well known for their brilliance, length, and strength and have long held at a premium in the international market. The black bristles produced at Ho-chuan, Nan-chung, Ta-hsien, and Pa-hsien (Fig. 39) along the Chialing River Valley are the best on account of their special brilliance.

The bristle-collecting season in the Basin extends generally from November to April, i.e., throughout the cold season. Generally no business is done during the rest of the year. This is mainly because the bristles grown during the hot weather are said to be soft and useless for manufacturing purposes. The Szechuan bristles, on account of their great strength, elasticity, brilliance, and relative immunity to moisture, are of a particularly high quality, and have long enjoyed a favorable reputation throughout the world. The best foreign buyers are the United States, which normally takes 30 per cent of the total exports; France and Japan, each taking about 20 per cent; and Germany and Great Britain, each taking about 15 per cent of the total exports. The principal use of the Basin's bristles in the United States are for tooth-and other high-grade brushes. But with the recent introduction of manufacturing bristles for such purposes in the United States, the prospect of this commodity, in so far as export is concerned, remains somewhat uncertain.

b) Sheep and cow hides.--While most of the provinces in China produce either water buffalos (as in South China) or oxen (yellow cattle) (as in north China), Szechuan Basin produces both. Among all the interior provinces in China, Szechuan Basin is the most important in the production of cow hides. The areas around Chengtu, Lo-shan, Lu-hsien, Pa-hsien, and Wan-hsien (Fig. 39) are particularly important. The cow hides produced in Chengtu Plain, owing to the good pasture nearby, are especially abundant in quantity and superior in quality. It is estimated that the annual output of cow hides, including both the water buffalo and the yellow cow, is approximately 50,000 piculs. Formerly, on account of the lack of tanning establishments in the

Basin, 70 to 80 per cent of the total production was exported as raw materials. But during recent years, since the rapid growth of local tanning industries, the hides are mainly used for manufacturing shoes, boxes, and other leather products consumed in the Basin.

Besides, the buffalo horns are also commonly utilized in Chengtu and other districts for the manufacture of a great variety of articles for everyday household use.

c) Sheep hides and wool.--There are two kinds of sheep hides produced in the Basin, namely, the garment-making hide, produced in the Sung-Pan area at the northwest edge of the Basin, and the leather-making hides, produced in the Chengtu and Wansien areas (Fig. 39). Normally, the total annual output of sheep hides is around 30,000 piculs. In 1935 the Basin exported 1,500,000 sheep hides, at a value of \$1,500,000.¹ Normally, the United States takes about 40 per cent of the total export, with Great Britain, Japan, Germany, and France following in order.

A large quantity of wool, totaling nearly 40,000 piculs annually, is produced in the Basin. Sung-pan, Li-fan, Wen-chuan, and other districts at the west and northwest edge of the Basin are the principal producing centers (Fig. 39). Nearly 85 per cent of the total production of wool is shipped down the Yangtse in raw material form. It is either exported directly to Great Britain or sold to local mills in Shanghai for manufacturing purposes.

d) Silk.--Szechuan Basin has long been well known in all China for its production of yellow silk. The Basin is second only to the two most important silk-producing provinces of China--Chekiang and Kwangtung. Normally, the Basin produces about 20 per cent of the total silk production of all China, and has an annual output of 30,000 piculs.² In the past, silk has always been the leading export of the Basin. In 1930, a peak year, the total export amounted to 20 million dollars, which constituted 15 per cent of the total export silk trade of all China in that year.³ But recently, on account of inefficient methods of

¹Bureau of Central Agricultural Research, Szechuan Provincial Government, Agricultural Statistics (1935).

²T. S. Fan, "The Past and Future of the Silk-worm Industry of Szechuan," Reconstruction Weekly, IV, No. 6 (1933), 34-42.

³China's Inspector-General of Customs, Analysis of Foreign Trade of China (1930).

production and lack of uniformity in the product, together with the general world economic depression, Szechuan silk has suffered a great setback. In 1936, only about one million dollars' worth of Szechuan silk was exported. Of all the agricultural products of the Basin, the decline of silk is perhaps the most tragic.

There are three chief silk-producing areas in the Basin (Fig. 39): (1) The northern area, including Santai, Nanchung, Lan-chung, Si-chung, and nearby districts; normally accounts for about 40 per cent of the total production of the Basin, totaling about 15,000 piculs.¹ Here, particularly in the district of Santai, the world-famous Szechuan yellow silk is produced. (2) The southern and southwestern area includes Lo-shan, Mei-shan, Ching-shen, Fu-shun, Jen-shou, and Chi-chiang districts. Among them, Lo-shan is particularly well-known both as a producer of raw silk and as a large manufacturing center of silk piece goods. In 1936 Lo-shan alone accounted for over 20 per cent of the Basin's total silk production. (3) The eastern and south-central area includes Ho-chuan, Tung-liang, and Wan-hsien districts (Fig. 39). Normally, they each have an annual output of a little over 4,000 piculs.

There are two main species of silkworm raised in the Basin, namely, the *Antherae pernyi*, a wild species, and the *Bombyx mori*, the regular mulberry-fed domesticated species.² The wild species is fed on the leaves of "cha shu" (*Cudrania triloba*) or scrub oak. In the Chi-chiang and Chi-hsien districts to the south, and Lanchung (Paoning) and Nanchung districts to the north, a considerable quantity of silk is obtained from this wild species. It is commonly claimed that worms of this wild species have the following advantages over the domesticated species: (1) the leaves of the Cha-shu (*Cudrania triloba*) come out a little earlier than the mulberry leaves and are usually cheaper in price; (2) the silk produced is tougher and stronger in texture; (3) the worms give more silk; and (4) two crops are possible yearly. This practice of raising the wild silkworm is particularly popular in the southern area, where Cha-shu trees are especially common.

¹The production figure of 1936 (Table 12) is low due to dwindling of export markets.

²C. H. Chiang, The Raw Silk, a Principal Product of Szechuan (1936), p. 39.

In spite of what has been said above, the silk produced by the wild species is, on the whole, inferior in quality and is negligent in quantity in the Basin. The major portion of silk produced in the Basin, about 80 per cent of the total, is derived from the regularly mulberry-fed, domesticated species--the *Bombyx mori*.

Silkworm rearing takes place twice a year in Szechuan Basin, as against only once a year in many other parts of Free China. It is carried on principally as a side-line by individual farmers. No large organized enterprise for silk-raising has ever been attempted. This accounts for the low efficiency in the methods of production and is mainly responsible for the meteoric downfall of the industry during the past few years in the face of serious Japanese competition in the overseas silk markets.

Recently, the Bureau of Agricultural Research of the Szechuan Provincial Government, in view of this grave situation and the serious effects it has on the general agricultural economy of the Basin, has taken rigorous measures to improve the methods of silk production. A number of silk-raising experimental stations and breeding centers have been established throughout the silk-producing areas, particularly in Nan-chung, Lo-shan, and Santai districts. In each district, numerous sub-stations have been organized to guide the farmers in silkworm raising, mulberry growing, and silk-making. Lo-shan alone has fifteen such stations. Other projects have also been launched to furnish more modern equipment and to organize the whole silk-production industry on a scientific basis.

Szechuan silk made a bid for world fame about eleven years ago in 1930, when 4,000 piculs were exported via Shanghai. This favorable condition was maintained for several years. Then a slump occurred due to the competition of Japanese silk and the increasing use of rayon. The war has presented a magnificent opportunity to revive sericulture in the Basin, while the boycott of the Japanese product in America since the American-Japanese war has now further stimulated export of silk from Free China. Szechuan today remains the only big silk center in the interior, as the silk colonies in Yunnan, Sikang, and Shensi are only beginning to export. With the growing American demand for Chinese silk, the Szechuan Silk Corporation is doing its best to increase its output.

The principal overseas market for Szechuan silk at present (shortly before the war) is in the United States, France, and Burma. For exports to the first two markets, silk is normally shipped down the Yangtse to Shanghai for overseas transshipment, whereas silk for the Burma market ordinarily goes by way of the Lo-shan-I-ping via Kunming, Yunnan route. The difficulty of transportation by way of the latter route is stupendous. Ordinarily it takes at least three to four months, by human carriers, for one trip from Lo-shan to Rangoon, Burma, and the transportation costs sometimes run as high as two-fifths of the value of the goods themselves. Unless transportation facilities along this route are improved, no matter how strongly the Burmese favor Szechuan silk, as has been the case thus far, the silk trade between Szechuan and Burma will always remain greatly limited.

Besides the difficulty of transportation, silk production in the Basin is now confronted by new handicaps. Silkworm rearing, formerly a profitable supplementary rural industry, has now given way to the production of grains (many mulberry fields have been converted into grain fields) which have been commanding high prices during recent years as a result of the increasing demand for foodstuffs due to the war.

e) Duck feathers and other products.--One cannot very well close this section on livestock production of the Szechuan Basin without mentioning another interesting product--duck feathers. The Basin normally has a total of over fifteen million ducks.¹ They are especially concentrated in the districts around Chengtu Plain, Lo-shan, I-ping, Yo-chi, and Pa-hsien (Fig. 39). Besides the wide use of the meat for food by the natives, the feathers are especially valued by the wealthy people for use in making light, warm and soft comforters, filling pillow cases and quilts, spinning yarn, weaving cloth, and a number of other uses.

The total production of duck feathers is estimated to be approximately 10,000 piculs annually. Approximately 70 per cent of the total product is shipped to markets overseas. Before the war, France was the leading customer, taking 30 per cent of the total export, with the United States and Great Britain each taking 20 per cent, and Germany and Japan each taking about 10 per cent.

¹Report of the Bureau of Central Agricultural Research (1939), p. 63.

F. Conclusions on Agricultural Land-Use

Agricultural land-use of Szechuan Basin emphasizes the diversity of its agricultural products and the intensiveness of its land-use. The diversified topography, the great variation in availability of water supply, the different degrees of alluviation in different parts of the Basin, and above all, the high population density, all have contributed to the uniquely different agricultural landscapes in various parts of the Basin. The sharp difference between the appearance of Chengtu Plain and the rest of the Basin is particularly striking.

Geographically, it is interesting to note that in this area people with limited technological knowledge at their disposal have struggled through long ages of painstaking experiment, successes and failure, by trial and error, to find out the most effective way to wrest a living from the none-too-favorable environment. For ages, the Szechuanese have employed their ingenuity, their patience, and their tremendous man-power in trying to utilize every available spot of land for whatever type of crops would grow under its particular physical qualities.

The tremendous work of terracing; the diversified methods and ingenious devices for irrigation; the unique methods of soil culture, green manure, and fertilization composting; the complicated systems of rotating crops; the synchronization of the seasons of planting of various crops; and the elaborate and widespread practices of inter-culture, are all good examples of the effort to attain intensive agricultural land-use and greater production.

Here, in the Szechuan Basin, one finds a most distinctive case of how man and Nature have worked together, hand in hand, and it is plain that the vast human effort has served as the most important single factor in shaping the present patterns of agricultural land-use. The building and maintenance of various kinds of irrigation works, the terracing of huge hills into minute steps, the various practices of soil culture (such as carrying soil from lower slopes to higher fields), all these in the absence of mechanical power, require a tremendous army of labor. In addition, there are the stupendous and astounding job of transforming the dry fields in winter crops (such as wheat, beans, etc.) into wet fields for rice, and transplanting millions of young rice plants (one by one, by hand), within the short period of two weeks

in early spring every year. Such agricultural practices and such intensive use of land as now prevail here in the Basin can only be maintained by abundant and cheap labor. In fact, it is the pressure of large numbers of men on the land that has resulted in the unique pattern of agricultural land-use here.

Owing to the crowded population, to the limited land area, and to the extremely low standard of living, it is imperative to the Szechuanese that every inch of land which is cultivable at all be brought under cultivation. Many times, of course, this means very low production efficiency per capita.

The crop systems in the Basin are so adjusted and so synchronized as to utilize each piece of land to the maximum. For instance, if physical conditions, particularly water supply, permit, rice is always the preferred crop. If rice cannot be grown, the next best crop, such as wheat, corn, millet, or barley, will be planted. If even these crops are impossible, still other crops will be grown, and the land put to some productive use. The simple truth is that here millions of mouths have to be fed, and the Szechuanese absolutely cannot afford to let their land lie idle if this can be avoided in any way. Given the known physical assets, with the available technological knowledge, one may fairly say that the Szechuanese, so far as agricultural land-use is concerned, have made a shrewd "deal" with their physical surroundings. Another people with the same equipment, under the same conditions, both physical and cultural, perhaps could not have done in any way materially different from the Szechuanese.

Nevertheless, in spite of all that has been said above, the agricultural land-use of Szechuan Basin, especially in the light of modern technological development and in the face of modern scientific agriculture, cannot be said to be wholly satisfactory. As a matter of fact, many of the Basin's practices in agricultural land-use are miserably inefficient and call for drastic and immediate improvement. The extreme heterogeneity of the seed of nearly all the field crops, the lack of scientific seed selection and plant-breeding station, the marginal character and low efficiency of the production in many hilly areas, the lack of good drought-resistant crops in areas where natural rainfall is undependable, the failure in cotton-culture, the financial inability to obtain modern complete chemical fertilizers, the wasteful practices of the so-called "winter-storing-water-field"

system, and above all, the inefficiency of many of the superfluous ditches and irrigation works, are notable examples. The successful solution of any of these problems will undoubtedly bring about a higher efficiency in the agricultural land-use of the Basin.

CHAPTER IV

FORESTRY LAND-USE

A. Principal Lumber-Producing Areas and Lumber Products

Most of the forested areas of the Szechuan Basin are rather detached in nature and are composed of small original growths high in timber value. Exceptions to this generalization include the relatively small areas west and northwest of the Chengtu Plain, the dense coniferous-deciduous association (including mainly the genera of *Abies*, *Picea*, *Tsuga*, *Larix*, *Castanea*, *Quercus*, and *Liquidambar*), and the areas along the upper Tung River Valley (Fig. 8). Taking the province as a whole, including the mountainous areas surrounding the Basin, the forest area of Szechuan is estimated to contain about 26 per cent of the total land area of the province, some 360,159 square kilometers.¹

Generally speaking, there are five principal lumber-producing areas in the province (Fig. 8). Each of them is characterized by a reasonably good potential supply of lumber and by a production of some special species. The five areas are: (1) the upper Min River area, including Sung-pang, Miao-hsien, Miao-kung, and Wen-chuan districts. This area is dominated by pines, lien-shan (*Abies*), yun-shan (*Picea*), tieh-shan (*Tsuga*) and chang (*Cinnamomum*); (2) the Ching-I River Valley, including Tien-chuan, Pao-hsin, and Yaan. It is dominated by Chih Shan (*Cunninghamia Lanceolata*), Yao Hu Tao (*Juglaus Cathayensis*), Ching Kang Li (*Quercus Glauca*), and others; (3) the Ta-tu River Valley, including Yueh-tsuin, Han-yuan, and O-pien. This valley is dominated also by Tiao Shan (*Picea Brachytyla*), Tien Shan (*Tsuga Yunanensis*), chu (*Castanopsis*), Kao (*Lithocarpus*), muho (*Schima*), and many others;² (4) the Tung River Valley area, including Tung-chiang,

¹Special Report on the Forestry of Szechuan, National Central University Publication (1936).

²Chen Wan Chung, Report of a Survey on Forestry of the Ta-tu River and Min River Areas (1936), p. 14.

Nan-chung, Cheng-ko, and Wan-yuan districts. This area is dominated by pines, banyans (Fig. 40), and cypresses, which, however, are not of very high timber value; and (5) the northwestern hilly area of the Basin, including Santai, and Chien-ke, Pai-chuan districts. This area of hilly country is dominated by pines, cypresses, some Nanmu, and some firs (Fig. 8).

Of the five areas mentioned, the Ta-tu River Valley and the Ching-I River area are by far the most important. Here virgin forests of great timber value are in abundance. Both are now under development by government and private interests. These forests will prove especially valuable for the many immediate needs in the Basin, such as construction on the Chengtu-Chungking Railway line, mining, and paper-making. Some logging activities are carried on in nearby camps, and the timber sawed is used by local towns and villages. But, however, large portions of the lumber produced are made into rafts and floated down the swift Ta-tu and Min rivers. A few saw mills, equipped with simple traditional devices, are located at Chengtu and Loshan. The wood sawed, transported either by small native boats or frequently on men's backs, found its market in various parts of the Basin, especially in the urban areas of Chengtu, Loshan, Luhsien, and other cities. Sometimes, however, such lumber finds its way as far as Chungking and other eastern areas where imported lumber often dominated the market.

The Szechuan Basin contains at least thirty different kinds of trees of high timber value in the Basin.¹ These include such outstanding and well known Chinese conifers as the Pai shu or cypress (*cypressus funebris*), the Ma Wei sung (*Pinus massoniana*), the Chia Shan (*Cunninghamia lanceolata*), the Ying Tsung (*Abies delavayi*), the Me Tiao Shan (*Picea ascendens*), Hsiang Peh Sha (*Juniperus Saltuaria*), and a number of outstanding hard woods, such as the Nanmu (*Machilu nanmu*), the chestnut (*Castanopsis*), the Hu-tao (*Juglaus rigia*), the Chang (*cinnamonuna camphora*), and the Chu li shu (*Quercus serrata*).

Among all the foregoing species the Chia-shan, Ma Wei Sung, Nanmu, Hu-tao, and Pai shu are the most important. They are the most common sources of timber supply for the Basin. The

¹Pei Chi Heng, A Survey of the Timber Trees of Szechuan Province (1937), p. 26.

Chia Shan (*Cunninghamia lanceolata*) deserves special mention as it is the most common tree for all-round use in the Basin. Not only because of its wide distribution throughout the Basin, particularly on the mountainous areas bordering the northwestern corner of the Chengtu Plain, but also because of its special adaptability and quick growth on the cretaceous sandstone soils, this tree has proved especially popular among farmers in the Basin. It generally grows from 80 to 120 feet tall and has a very straight stem. After the trees are cut down, this conifer reproduces itself by sprouts from the old stumps, requiring no seeding or nursery cultivation. The bark is commonly employed for roofing purposes. The wood is light, fragrant, and easily worked. For general building purposes, house-fitting, indoor carpentry, and boat-building, it is the most esteemed of all Chinese timbers. It is also in great demand for coffin-making, the fragrant properties of the wood being believed to act as a preservative.

Besides the Chia Shan, the most unique, if not the most commonly used tree, is the Nanmu (*Michilus Nanmu*). It is one of the most valuable broad-leaf evergreen hardwoods, comprising several species of Lauraceae. The timber is close-grained, fragrant, greenish or brownish in color, easily worked, and very durable.¹ It is the most highly prized timber for high-grade construction purposes, such as for the pillars and beams of palaces, temples, and other important structures. It is also used in the best grade furniture and cabinet work, and is commonly sought by the wealthy Chinese for making their coffins. It is among the most graceful and beautiful evergreens in the Basin. The trees are somewhat localized and are found particularly in abundance in the Min River Valley, near Chengtu Plain and some western hilly areas of the Plain where there is a dependable water supply near the irrigation streams.

In addition to the trees of the foregoing timbered areas, the bamboo thickets constitute another important source of timber supply in the Basin. The bamboo is a fast-growing plant and has many different species. The vegetative bodies and growths of the bamboo differ in these different species. Bamboo varies from the dwarf shrub of about 10 feet tall, with a diameter of 3-4 inches,

¹Pei Chi Heng, op. cit., p. 42.

as in the case of Kuang Ying bamboo, to giant tree of well over 80 feet in height and with a diameter over 12 inches, as in the case of Nan Chu and Tze Chu bamboos. They often grow in thickets, groves or clumps and usually have a golden, yellow or dark green foliage and with broad sheaths. There are numerous slender stems developed around the large clumps and the principal stems. The stems are hollow inside, have many joints, and often have thick wood which furnishes the most useful part of the plant.

Bamboo has a fairly wide range of habitat and grows well under different kinds of physical conditions.¹ The principal habitats of the bamboo are in alluvial areas near streams, around farmsteads, and not infrequently on sandy soils at the hill slopes.

The usefulness of the bamboo is indeed limitless. First of all, the tender bamboo shoots are used as a vegetable, and serve as one of the most famous Chinese delicacies. The smaller stems are used for paper-making, textile-weaving, making of boxes, baskets, chopsticks, and light house utensils and furniture, whereas the large stems are used for the construction of irrigation wheels, salt brine and gas tubes, boats, bridges, carpentry, and numerous other industrial purposes. All in all, it was once reported that the bamboos are used in more than six hundred different ways in the Basin.² Thus the bamboo, to be sure, plays a very important role in the economy of the Basin. Above all, the bamboo, on account of its growths of matted fibrous roots, is proved most effective in holding soil and preventing soil erosion in many hilly areas of the Basin.

There are few large bamboo plantations in the Basin. Most farmers have small patches of bamboo thickets or groves around their farmsteads. The bamboo products are used principally for the farmer's own needs and any surplus left is sold to handicraft manufacturers of the nearby areas.

¹Generally speaking, bamboos cannot stand up very well under drought conditions. North of Kuang Yuan, for instance, on account of the lack of sufficient moisture, and possibly also because of lower temperature during the winter, no bamboo is grown (Fig. 8). Also, generally, very little bamboo growths are found around high altitudes of probably over 5,000 feet above sea level in the Basin.

²T. F. Hou, "The Conditions of Salt Fields at Tze-liu-ching and Kung Ching, Szechuan," Szechuan Monthly, VIII, No. 6 (1937), 59.

B. The Tung Tree Production

The tung-oil tree "belt" of China lies in the area between 22 and 33 degrees north latitude, and 100 and 120 degrees longitude east. Within this area is included the whole province of Szechuan (Fig. 1) and, in fact, normally Szechuan produces about a third of the total annual production of tung oil in China. It is commonly asserted that Szechuan Basin possesses the most favorable natural environment for growing the Tung tree. Certainly, it is the most distinctive and the best known product of Szechuan Basin. The Tung tree now occupies a vitally important position in the economy of the Basin as is evidenced by the fact that it comprised as much as 65 per cent of the total export trade of the Basin in 1940.¹

1. Physical Requirements for Tung Tree Production

The mild, almost frostless winter, the moderate rainfall, the high humidity and cloudiness, and the high summer temperatures all are favorable to the growth of the Tung tree in the Szechuan Basin.² The customary sudden drop of temperature in the early spring for a short period just at the time of flowering of the Tung trees, locally known as "tung tung hua," or "frozen tung flower weather," the cause of which is not yet known, is considered especially favorable for the growth of Tung trees. This common assertion has recently been confirmed by American experts who have compared the results of Tung-tree growth in Florida with that in the Basin.³

The Tung tree is essentially a hill-side plant. It thrives well on the most rocky sites, on the poorest and thinnest soils, and with a minimum annual rainfall of 29 inches. Anyone who has traversed the gorges above the Yangtse may notice these low-growing, flat-topped Tung trees, clinging to the rocky banks on soil no more than a few inches deep. The Tung tree is noted for its capacity to withstand drought and this and other conditions fit

¹K. K. Yen, "An Analysis of Foreign Trade of Tung Oil of Szechuan," Journal of Foreign Trade, March, 1941, p. 27.

²Hu Liu, "The Production of Tung Oil in Szechuan," Szechuan Monthly, III, No. 6 (1932), 13-21.

³Ibid., p. 15.

it wonderfully well into the general topography, soil, and climatic conditions of the Basin.

2. Principal Producing Areas

The Tung trees grow over wide areas of the Basin, but the three principal producing regions are: (1) the Yangtse area, including Ning-shui, Yun-yang, Wan-hsien, Kai-hsien, Chung-hsien, and Feng-chieh districts; (2) the Chien and Chi River areas, including Yu, Siu-shan, and Pei-ling districts; (3) the Chialing River area, including Ho-chuan and Pa-hsien districts (Fig. 36). Among them, the Yangtse Valley area, especially the districts near the anticline belt, is by far the most important.

The total annual production of tung oil is estimated to be about 760,000 piculs.¹ In 1936, Ning-shui, one of the districts which makes up the first of the three principal producing areas, led all the districts with a total annual production of 180,000 piculs; Chung-hsien, of the same producing area, in the second place, produced 140,000 piculs; and Yun-yang produced 100,000 piculs (Table 13).

The Tung trees (*Aleurites fordii*) which grow in the Basin are of two kinds--Chai tung, or fuel tung, and mi-tung, or rice tung. The Chai tung is taller in height, generally around 20 to 25 feet, and has rougher and larger branches. The fruit contains fewer seeds (only three to five) than the Mi tung, and thus has less oil content. Hence, very few Chai tung trees are planted here.

The Mi tung tree, the major kind planted in the Szechuan Basin, is shorter in height (about 15 feet or less) and is highly ornamental in flower and foliage. The flowers, produced in great profusion during April, are usually white, stained with pink and yellow markings. These are followed always by green apple-like fruits, which are hidden among the large, glossy, heart-shaped leaves and generally ripen between August and September. Each fruit usually contains five to seven seeds. The Tung trees begin to bear fruit in their fourth year, and their period of

¹C. S. Chang, The Tung Oil of Szechuan (Ming Seng Co., 1936), p. 18. But the most recent report gave the total acreage of Tung tree for 1940 as 1,150,000 mow and with an annual production of 1,140,000 piculs (cf. Yen, op. cit., p. 31). This is, of course, a little unusual and is due to the war time boom production.

greatest production is from the eighth to the sixteenth year. A decline in productivity begins with the seventeenth year. Thus there is a local saying, "The seventeenth year is the limit for the Tung Tree."

The tung seed-collecting season varies from locality to locality in the Basin, but, on the whole, comes in the middle of September. After the green fruit is picked, it is piled into heaps and covered with straw or grass. The heat thus generated quickly rots the fleshy part of the fruit and the seeds are removed. They are then roasted,¹ ground, steamed, and pressed, like other oil-producing seeds. All of these processes are done with very simple equipment and at low efficiency. The roasting and steaming are done by burning of charcoal or coal, whereas the pressing and grounding are all done by animal power. The product, which amounts to about 40 per cent of the weight of the seed, is a brown and somewhat watery oil. It is sent to the nearby local plants for refining, and then packed in wooden tubs and bamboo baskets to be shipped down the Yangtse to Shanghai for export abroad.

In the economy of the Szechuan Basin the Tung tree figures as a natural mountain product. Usually, the trees are left to grow wild; very little attempt is made by the farmers to cultivate them. Only during recent years, following the continuous success in the export trade, have a large number of Tung tree plantations and nurseries been organized and scientific methods applied to cultivation and production. The best known plantations are the I-shui at Wan-hsien, and the Jen-ho at Pi-shan. Each comprises from 200,000 to 300,000 trees. Both have met with phenomenal success during the past few years. An increasing number of such plantations, sponsored either by the government or by private interests, have recently been organized.²

3. Transportation and Marketing of Tung Oil

The present war has greatly stimulated the production of tung oil in Szechuan and has brought drastic changes in the

¹Roasting is, however, not essential and is not practiced by all farmers.

²Chao, op. cit., p. 21.

marketing and transportation of the product. Prior to the war, Wan-hsien, between Chungking and Hankow, was the most important shipping center for Szechuan tung oil, as well as other products. Its importance was due to its geographical location on the main waterway to Shanghai via Hankow. But, however, since the fall of Wu-Chang-Hankow tri-cities and consequently the close of the gorges route to the east due to the enemy's blockade, this route of transshipment of tung oil has been greatly shifted. Now, Chungking, because of its new political importance and because it is the starting point of new highways in southwest China, has become the most vital concentration point and the sole exporting center of tung oil. While in 1935-36 the oil sent to Chungking for transshipment (totaling 150,000 quintals) was only three-fourths that sent to Wan-hsien, the 1938 figures for Chungking showed an increase to 350,000 quintals.¹ The amount sent to Wan-hsien, on the other hand, dropped to 150,000 quintals,² only a little over one-third that sent to Chungking. Districts that formerly sold their oil through Wan-hsien now turn their products over to the purchasing agents of the Foreign Trade Commission at Chungking.³ This newly created concern, with the cooperation of both government and private interests, collects the processed oil and exports it abroad by way of the Kweichow-Szechuan highway (Fig. 18) through the back door of China.

In 1938, 42.9 per cent of the local oil came from points east and south of Chungking, 24.4 per cent from places along the Chialing and Chu rivers, 14.2 per cent from the Chien and Wu River valleys, 17.1 per cent from points along the Yangtse above the city of Chungking, and the remaining 1.4 per cent from other places.⁴ This kind of tung oil concentration and shipment is consistent with the general patterns of its production, because the principal tung-oil-producing areas, as already mentioned, are concentrated in the districts both north and south of Chungking, and in the upper Chialing and Chien River Valley areas.

¹Foo-hsing Trade Corporation, Trade Report (1939), p. 32.

²Ibid., p. 34.

³Ibid., p. 38.

⁴Ibid., p. 41.

Tung oil is widely used in the modern industrial world. It has been proved particularly invaluable in making high grade paints, in boat-building, and in the manufacturing of many other water-proof products. The refuse cake, chemically a complete fertilizer, is valued highly by the farmers of the Basin for fertilization purposes. It is used especially for the dry crop fields, such as corn, kaoliang, and other crops, but is very seldom applied to the rice-fields. It is reported that these tung-cake fertilizers are particularly suitable to the corn crop.¹ The shells of the tung seed, together with rice and soy bean stalks, burned and treated, are commonly used to prepare a cheap soap for the local farming families.

China now produces about 85 per cent of the total world supply of Tung oil, and the production of Szechuan Basin alone accounts for about 40 per cent of the total tung oil export of all China. The best customer was the United States, which, before the war, took on an average about half of the total production. Other customers were Germany, with about 25 per cent of the total; England, with about 15 per cent; and France, Italy, and Japan, each with about 5 per cent of the total annual export.

From the standpoint of the agricultural economy of the Basin, the production of tung oil is vitally significant. Even apart from the huge amount of cash income it brings in the export market, the value of the refuse cake for fertilization, and other industrial purposes, such as the manufacturing of soap, the total value of the Tung tree to the farmers of the Basin is incalculable. Hence, the Bureau of Agricultural Research of Szechuan has recently launched an ambitious ten-year expansion program to boost the Basin's Tung-tree production. It aims to increase the present yearly production of oil from 400,000 quintals to 1,000,000 quintals. At the same time, the Foreign Trade Commission together with the Ministry of Agriculture and Forestry have a five-year plan for increasing tung-oil production in Szechuan, Hupeh, Hunan, Kweichow, and Kwangsi to 650,000 quintals per year. In addition to existing Tung trees, according to the five-year plan, Szechuan is to plant Tung trees on an additional 500,000 mow of land as a necessary step in the expansion program.²

¹Y. J. Hsiao, "A Study of the Agricultural Practices of Szechuan," Reconstruction Weekly, IV, No. 7 (1933), 6.

²Bureau of Agricultural Research of Szechuan, Annual Report (1940), p. 76.

4. Future Outlook of Tung Tree Production

In spite of the fact that Szechuan Basin has now virtually a monopoly in the production and trade in tung oil, and in spite of the increasing demand for tung oil in many modern industries, both in China and in the international market, the future prospect of tung-oil production in the Basin remains uncertain. With the traditional conservatism in agricultural practices, the lack of efficient scientific management, and the lack of standardization in the product, one, particularly one who is familiar with the tragic outcome of many of China's outstanding products in the international market in the past, cannot but withhold his optimism for the future of tung oil. It may well be asked whether this celebrated product may not have the same tragic fate as silk and tea, of which China once also had the monopoly in international trade. This skepticism is particularly justified in view of the widespread cultivation of the Tung tree in Florida in the United States, and in British South Africa,¹ and the potential competition implied in days to come. As a matter of fact, the future position of tung oil in the Basin, in so far as its export is concerned, is precarious and uncertain. But, however, with the growing industrial expansion in a forthcoming new China and with its increasing usefulness for numerous industrial purposes, as well as the growing popularity of the tung cakes for fertilizers, the tung-oil plantation of the Basin may perhaps look forward with some degree of confidence in its expansion programs and success in the near future.

In order to meet the anticipated keen international competition in Tung tree production, it is imperative that certain essential measures of improvement be taken immediately by the growers of Tung trees in the Basin. Among other things, the extension of the cultivated Tung tree acreage at the expense of the traditional "wild" production, should claim first attention. The establishment of large-scale, well-organized, and modern-equipped Tung tree plantations is absolutely necessary. Moreover, the selection and improvement of seeds, improved methods of cultivation and fertilization, increased efficiency of the native oil-pressing techniques, wider use of more modern appliances and

¹"Recent Developments in the Vegetable Oil Industries," Geographical Review, XXVI (1936), 334-35.

equipment, and the standardization of the finished product are most important.¹

Recently, realizing the necessity of such improvements, the Bureau of Agricultural Research of Szechuan has established four model Tung tree experimental stations at Pei-ling, Nan-chung, Ning-shui, and Wan-hsien districts in order to direct the essential improvement work. With the author's experience among the tung farmers in the Basin, he feels strongly that it is probably wiser for the Agricultural authorities here to carry on the improvement work along the lines suggested above rather than aiming merely to boost the present acreage. Successful modern commercial agricultural production means high quality, as well as quantity. It would be heart-breaking to witness the same tragic fate befall the Tung tree, generously favored as it is by the Basin's physical conditions, that befell China's silk and tea. Nature has already done her part, and it is now up to man to do his.

C. The Wax Tree Production

1. The White Wax Tree

White wax, produced by the secretions of tiny insects, locally known as Pai-lou-chung (*Coccus pela*), on a number of wax trees or shrubs, is another unique forestry product of the Szechuan Basin. The so-called wax trees or shrubs consist of over ten species, including both conifers and broad-leaved hardwoods. One particular species of conifer, locally known as Pai-Lou-Shu (*Fraxinus Chinensis*), is the most important and the most common species on which the wax insects are raised.

There are two main species of wax insects: Shan Ti Tsung, or the hilly insects, including breeds produced in Hui-li, Hsi-chang, Ning-yuan,² and Kuan-hsien districts, and Pa-Tsung, or insects of the plain areas, including breeds produced in O-mei, Lo-shan, Chien-wei, and Hung-ya districts (Fig. 36). Generally speaking, the plain insects are inferior in quality and are not used for breeding purposes. Also, it is reported³ that in the

¹Chao, op. cit., p. 24.

²Hui-li, Hsi-chang, and Ning-yuan districts are now under the jurisdiction of Sikang province.

³Ho, op. cit., p. 15.

neighborhood of Lo-shan and other districts to the north, the insects cannot survive the winter. Each year the wax tree growers have to dispatch special messengers on foot to secure eggs or breeds of insects from the hilly regions, particularly the Chien Chang area in the Ning-yuan district of southern Sikiang province, which is about 250 miles distant from the principal wax-producing centers at Lo-shan.

Owing to the long distance involved, and the slow and difficult transportation conditions, as well as the great variation in climatic conditions between the warm insect-producing southern areas and the cool wax-tree-growing districts to the north, there is involved great risk in transporting these insect breeds. The carriers travel night and day, and generally the trip is covered in sixteen to twenty days, for this is the period during which the eggs are expected to hatch. Once the little larvae start crawling around, the carriers have no alternative but to throw them away. This alternative, of course, means great financial losses to the wax-tree growers, and has become one of the most serious problems of the wax-tree industry in the Basin.

The principal wax-producing areas are concentrated in the southwest of the Basin, particularly in the districts of O-mei, Hung-ya, Chia-chiang, Lo-shan, Chien-wei, and Kuan-hsien (Fig. 36). The total production of white wax in the Basin varies with the climatic conditions. Wind and rain are very much dreaded, particularly at the season when the insects are in suspension. These insects, exposed as they are on the tender branches of wax trees of one or two years' growth, are too weak to resist strong wind or heavy rain.

Normally, the total annual production is around 20,000 piculs. But during recent years, the total production has amounted to only 5,000 piculs, about a fourth of the usual production. This present sharp decrease in white-wax production is, however, due not so much to climatic adversity as to political instability and heavy taxation in the Basin. The greatest enemy of white-wax production in Szechuan Basin is the stupendously difficult conditions of transportation. The newly completed Szechuan-Yunnan western highway will undoubtedly relieve the transportation difficulty, and will accelerate the development of the industry in the Basin.

The most commonly cultivated white-wax tree, the Pai Lou Shu (*Fraxinus Chinensis*) is a fast-growing tree of medium size. In outer appearance it is very much like a willow tree but generally not as tall (Fig. 41). It prefers a mild and humid climate. It grows readily from cuttings of the one- or two-year-old branches of the mother tree. After three or four years the tree is suitable in size for wax production. It furnishes a rich sap, which by itself is of no value and is used to nourish the insect. The metamorphosis of the wax insect is similar to that of the silkworm. From egg it becomes larva, pupa, and eventually adult. It takes one year to complete its life cycle. It is the male larva which produces the wax, while the female merely lays eggs to carry on the line. The present strain in Ning-yuan district is said to be five hundred years old.

During the early spring the eggs of the insects wrapped in leaves of the Tung or some other tree, with holes pierced for air, are suspended on the branches of the wax tree to hatch. Generally, the insect prefers the tender young branches of two- or three-year-old trees, of which the sap is rich and the epidermis of the branches is soft enough for the young insects to break through. Within forty to fifty days after the eggs are hatched the wax appears upon the tree and gradually increases until the early autumn (September), when the harvest begins. The snow-white wax accumulated on the main branches is scraped down with sharp knives, while the wax on small twigs is cut down with the twigs. The wax is then steamed and refined two or three times, until the pure white wax is precipitated.

The white wax has a wide scope of uses, including candles, glazing for paper, silk, furniture polish, coating for pills, models, polish for valuable metal utensils to prevent oxidation, and many medicinal purposes. The residue from white-wax refining is often used for fertilizers. Formerly, about 80 per cent of the total product was exported to Japan and the United States. But it now finds its markets in the interior provinces, particularly in Kansu and Shensi. It is reported that Chinese wax is superior¹ to any other wax produced in the world because it has no smell and leaves no stain whatsoever. Of particular importance

¹J. S. Ho, "The Wax Tree Culture and Its Problems in Szechuan," Chinese Reconstruction Weekly, XI, No. 6 (1940), 11-18.

is its high melting point--83 degrees centigrade. It is said that Thomas Edison used this white wax from Szechuan Basin to make his first gramophone records, which have since given pleasure to so many people in all parts of the world.¹

2. Yellow Wax Production

In addition to white wax, the Szechuan Basin also produces a considerable amount of yellow wax from bee hives. According to Buck, Szechuan farmers lead all China in the average number of bee hives per farm.² They are particularly important in the districts of Kuang-yuan and Kuan-hsien, in the north and west of the Basin (Fig. 36). The total production is generally estimated to be around 34,000 piculs, with Kuang-yuan, as the leading producer, accounting for a fourth of the total production. The yellow wax, like the white, is used mainly for candles, furniture polish, models, and many medicinal purposes. But, unlike the white wax, it is consumed principally within the Basin.

D. The Varnish Tree Production

Lacquer and lacquer wares in Szechuan have been famous ever since the early Han dynasty. The main producing areas are in the districts of Kuang-yuan, Chao-hua, and Tung-chiang, to the north, and Nan-chuan to the south (Fig. 36). The northern areas are the most important. The total annual production is approximately 4,000 piculs.

The varnish is obtained by tapping the stems of the tree (*Rhus vernicefera*), locally known as Tsi Shu, by making horizontal incisions in the bark. Generally, these incisions are first made and the tapping begun when the tree is seven years old and has attained a diameter of six inches. Two years are allowed to elapse before the same tree is tapped again. The tapping season commonly begins in late June or early July, at the time corresponding with the opening of the flower, and continues throughout the summer. The sap, as it is exuded, is pure white in color, but quickly oxidizes to a grayish-white, and finally to black. To prevent this oxidation, the crude varnish is covered as soon as possible with layers of oil paper.

¹Ibid., p. 17.

²Buck, op. cit., p. 248.

Prior to the war a major portion of the raw varnish, about 90 per cent of the total, was exported to Japan. But now it is largely consumed within the Basin for manufacturing numerous lacquer wares, for which the Basin is famous in China.

E. General Conclusions

The discussion of the agricultural and forestry land-use of the Szechuan Basin in the foregoing chapters has revealed in sharp relief three significant facts, namely: First, the dominance of the agricultural and forestry land-use in the general economy of the Szechuan Basin is not only the most striking fact but the most illuminating concept in the geography of the Basin. The very fact that the Basin has the greatest diversity of agricultural products and is almost a miniature China in agricultural production typifies its extreme agricultural richness. Moreover, the astounding figures that about 85 per cent of the total population is engaged in agricultural pursuits and over 60 per cent of the Basin's export is derived from one single forestry product, the Tung tree oil, demonstrates clearly the ever-close bond between the well-being of the people in the Basin and its agricultural and forestry land-use. In addition, it is recently revealed that the Basin supplies about 60 per cent of the total food supply for the entire fighting force of China, comprising well over five million strong. This single fact alone bears witness to the vital part the Basin now plays in China's total war effort. Among other things, this rich agricultural and forestry production of the Basin is undoubtedly one of the most important factors, perhaps the determining one, which has induced the National Government of China to select the Szechuan Basin as the principal base of operation against the present invasion.

The second conclusion deserving special attention is the close correlation of the Basin's agricultural and forestry land-use to its environmental factors. The adjustments of agricultural practices to physical environment here are both genuine and many. To mention a few striking examples, the minute terraced fields, the intricate irrigation systems, the wide range and great diversity of agricultural and horticultural products, the numerous practices in soil culture and crop rotations, and the wide use of bamboos are related respectively to the topography, water supply, climate, soil, and vegetation of the Basin. Especially the lack

of modern technological knowledge has accentuated this relationship and has made this relationship appear overwhelming and somewhat one-sided. For instance, owing to the lack of breeding of drought-resistant varieties of crops, the hilly agriculture of the Basin has always remained precarious. Moreover, the limited engineering knowledge has prevented the farmer from obtaining a higher efficiency in their numerous irrigation works. But with the forthcoming introduction of modern technology and scientific agriculture, all these difficulties will be greatly alleviated and the Szechuanese will be able to secure a more efficient agricultural and forestry land-use and to enter into a more harmonious and reciprocal relationship with their physical environment.

Lastly, the evident trends of the rapid transformation and innovation in the various practices of the agricultural and forestry land-use, induced and intensified by the war, is a third important fact which deserves emphasis. Virtually, the Basin is now undergoing an economic and technological revolution. With the rapid influx of a great number of people with modern ideas from the lower Yangtse, there is an urgent call for greater efficiency in all phases of land-use in the Basin. Not to mention the phenomenal progress made along the manufacturing, mining, transportation and other lines, the Basin's agricultural and forestry land-use has been undergoing rapid transformation and achieving unprecedented progress. For instance, the revolutionary remedial measures regarding the traditional age-old Tung-shui-tien field system, the introduction and wide extension of the Tsa-Seng-Tao variety of rice, the drastic steps taken toward the cultures of cotton, sugar cane, tea, tobacco, and silk, and the various improvements and experimental works in connection with Tung trees and herbs, have already shattered to a great extent the fundamental structure of the agricultural and forestry land-use of the Basin. In view of the present trend of development, it is perhaps safe to say that irrespective of the outcome of the present struggle in China, the agricultural and forestry land-use of the Szechuan Basin will usher in a new era of higher efficiency and more prosperous development in the time to come.

A P P E N D I X I

(TABLES 1-14)

TABLE 1

TOTAL POPULATION AND POPULATION DENSITY
OF SZECHUAN BASIN (1937)
(By Hsien)

Name of District	Total Land Area (In Sq. Kilo- meter)	Total Population	Population Density (No. of Per- sons per Sq. Kilometer)
1. Ching-Hua.....	2,875	11,151	4
2. Li-Fan.....	11,984	22,749	2
3. Miao-Hsien.....	6,453	33,462	5
4. Pai-Chuan.....	1,716	28,513	16
5. Ping-Wu.....	6,079	79,243	13
6. Chao-Hua.....	1,541	104,197	67
7. Kuang-Yuan.....	6,151	140,572	23
8. Nan-Chiang.....	4,686	169,572	36
9. Tung-Chiang.....	4,980	238,421	47
10. Wan-Yuan.....	4,117	154,000	37
11. Cheng-Ko.....	4,307	60,861	14
12. Fu-Hsi.....	3,516	141,856	45
13. Fu-Shan.....	2,646	148,270	56
14. Miao-Kung.....	18,734	23,675	2
15. Wen-Chuan.....	3,242	18,594	6
16. An-Hsien.....	1,428	175,165	122
17. Chang-Ming.....	939	106,578	113
18. Chiang-Yu.....	2,651	239,577	91
19. Chien-Ko.....	3,457	275,344	80
20. Tsang-Hsi.....	2,399	259,243	108
21. Pa-Chung.....	4,737	540,453	114
22. Hsuan-Han.....	4,340	444,669	102
23. Kai-Hsien.....	3,700	662,481	179
24. Yun-Yang.....	3,369	517,398	154
25. Feng-Chieh.....	4,457	357,746	80
26. Pao-Hsin.....	1,679	21,022	13
27. Kuan-Hsien.....	989	306,812	319
28. Peng-Hsien.....	895	374,599	417
29. Shih-Fang.....	746	212,890	283
30. Mien-Chu.....	638	275,760	430
31. Lo-Chiang.....	699	154,042	222
32. Mien-Yang.....	1,565	431,878	275
33. Tzu-Tung.....	595	166,586	278
34. Nan-Pu.....	2,922	711,508	244
35. Nan-Chung.....	1,481	379,696	256
36. I-Lung.....	1,578	331,686	211
37. Ying-Shan.....	1,764	442,980	251
38. Ta-Hsien.....	3,549	615,198	173
39. Kai-Chiang.....	1,040	209,605	202
40. Wan-Hsien.....	3,667	780,787	213
41. Tsung-Nai.....	1,503	394,769	263
42. Ta-I.....	1,081	289,163	267
43. Tsung-Ching.....	1,116	393,333	352
44. Wen-Chiang.....	251	173,988	693
45. Tsung-Nin.....	178	92,014	516
46. Pi-Hsien.....	273	184,922	677

TABLE 1—Continued

Name of District	Total Land Area (In Sq. Kilo- meter)	Total Population	Population Density (No. of Per- sons per Sq. Kilometer)
47. Shin-Fang.....	159	102,685	646
48. Sin-Tu.....	344	145,770	420
49. Kuang-Han.....	499	268,561	538
50. Te-Yang.....	512	203,632	400
51. Chung-Chiang.....	2,458	927,952	377
52. San-Tai.....	2,733	959,632	352
53. Yen-Ting.....	1,237	320,087	258
54. Si-Chung.....	999	356,301	357
55. Nan-Chung.....	2,636	900,590	340
56. Peng-An.....	1,638	363,240	222
57. Chu-Hsien.....	1,657	728,049	439
58. Ta-Chu.....	1,826	418,139	230
59. Liang-Shan.....	2,408	416,790	170
60. Chung-Hsien.....	1,569	501,220	319
61. Shih-Chu.....	2,071	184,627	89
62. Ming-Shan.....	622	134,819	217
63. Pu-Chiang.....	501	129,135	258
64. Sin-Tsing.....	316	160,909	509
65. Peng-Shan.....	425	160,008	377
66. Shuan-Liu.....	288	134,716	467
67. Hua-Yang.....	957	378,330	395
68. Cheng-Tu.....	246	125,491	510
Cheng-Tu Municip.	41	496,128	12,101
69. Ching-Tan.....	1,411	535,357	397
70. Chien-Yang.....	2,502	1,026,158	411
71. Lo-Chi.....	1,158	447,354	387
72. Siu-Ning.....	1,814	703,152	388
73. Peng-Hsi.....	1,974	718,603	364
74. Shei-Hung.....	1,399	546,760	391
75. Wu-Sheng.....	1,079	358,342	332
76. Yo-Chi.....	1,859	556,690	300
77. Kuang-An.....	1,707	630,800	371
78. Liang-Shui.....	1,897	365,756	193
79. Tien-Chiang.....	1,706	299,110	170
80. Feng-Tu.....	858	224,442	88
81. Peng-Shui.....	9,131	207,777	23
82. Chien-Chiang.....	2,237	115,681	52
83. Yu-Yang.....	3,665	362,357	98
84. Siu-Shan.....	1,440	125,648	87
85. Tang-Ling.....	724	89,539	124
86. Mei-Shan.....	1,035	395,586	382
87. Jen-Shou.....	2,516	998,404	397
88. Tzu-Yang.....	1,733	591,491	340
89. An-Yo.....	2,769	760,020	275
90. Tung-Nan.....	1,751	402,957	230
91. Ho-Chuan.....	2,840	807,395	284
92. Chiang-Pei.....	2,472	662,718	278
93. Chang-Sheo.....	1,138	389,422	342
94. Pei-Ling.....	5,520	1,026,758	186
95. Hung-Ya.....	1,523	202,946	135

TABLE 1—Continued

Name of District	Total Land Area (In Sq. Kilo- meter)	Total Population	Population Density (No. of Per- sons per Sq. Kilometer)
96. Chia-Chiang.....	420	160,032	381
97. Ching-Shen.....	409	124,695	304
98. Ching-Yen.....	628	192,954	307
99. Yung-Hsien.....	1,965	593,929	302
100. Wei-Yuan.....	781	259,736	332
101. Tzu-Chung.....	1,905	731,856	384
102. Nei-Chiang.....	1,599	600,146	374
103. Yung-Chang.....	899	367,513	409
104. Ta-Cho.....	1,316	395,279	300
105. Tung-Liang.....	1,479	497,587	337
106. Pih-Shan.....	811	332,603	410
107. Pa-Hsien.....	3,312	911,492	275
107a. Chung-King Municip.....	94	453,427	4,824
108. Nan-Chuan.....	3,029	293,344	97
109. O-Pien.....	2,738	50,175	18
110. O-Mei.....	1,272	144,454	113
111. Lo-Shan.....	1,867	389,306	208
112. Chien-Wei.....	1,954	516,502	260
113. I-Ping.....	4,230	802,924	189
114. Fu-Shun.....	2,207	953,487	432
115. Lung-Chang.....	761	318,842	419
116. Lu-Hsien.....	2,913	954,649	328
117. Yung-Chuan.....	1,288	390,020	302
118. Chiang-Tsin.....	3,253	840,368	258
119. Chi-Chiang.....	1,839	406,270	221
120. Lei-Po.....	4,814	19,622	4
121. Ma-Pien.....	2,624	32,925	13
122. Ping-Shan.....	2,891	264,217	91
123. Kao-Hsien.....	1,394	139,482	100
124. Ching-Fu.....	1,077	174,113	162
125. Nan-Hsi.....	957	254,051	265
126. Chiang-An.....	740	213,262	288
127. Nei-Hsi.....	477	72,468	147
128. Ho-Chiang.....	2,329	383,771	165
129. Yung-Lien.....	342	62,246	182
130. Chi-Hsien.....	1,197	129,747	108
131. Chang-Ning.....	1,295	219,576	169
132. Hsing-Wen.....	526	63,763	121
133. Ku-Sung.....	598	100,040	167
134. Siu-Yung.....	2,916	286,046	98
135. Ku-Ning.....	5,589	362,210	65
136. Sung-Pan.....	50,139	22,533	2
Total.....	360,159	48,436,624	135

TABLE 2

INDEX OF CULTIVATED LAND TO TOTAL LAND AREA
IN SZECHUAN BASIN (1939)

Name of District	Total Land Area (In Sq. Kilo- meter)	Total Cultivated Area (In Sq. Kilo- meter)	Ratio of (3) to (2) in Per Cent
1. Ching-Hua.....	2,875	85	0.3
2. Li-Pan.....	9,667	24	0.2
3. Miao-Hsien.....	4,940	203	4.0
4. Pai-Chuan.....	1,716	57	3.0
5. Ping-Wu.....	6,097	198	3.0
6. Chao-Hua.....	1,541	523	34.0
7. Kuang-Yuan.....	6,151	923	15.0
8. Nan-Chiang.....	4,686	1,045	22.0
9. Tung-Chiang.....	4,980	996	20.0
10. Wan-Yuan.....	4,117	527	13.0
11. Cheng-Ko.....	4,307	215	5.0
12. Fu-Hsi.....	3,156	158	5.0
13. Fu-Shan.....	2,646	265	10.0
14. Miao-Kung.....	18,734	23	0.1
15. Wen-Chuan.....	3,378	34	1.0
16. An-Hsien.....	1,428	500	35.0
17. Chang-Ming.....	939	188	21.0
18. Chiang-Yu.....	2,651	1,398	53.0
19. Chien-Ko.....	3,457	1,069	31.0
20. Tsang-Hsi.....	2,399	719	30.0
21. Pa-Chung.....	4,737	1,128	24.0
22. Hsuan-Han.....	4,340	1,302	30.0
23. Kai-Hsien.....	3,700	1,295	35.0
24. Yun-Yang.....	3,369	842	25.0
25. Feng-Chieh.....	4,457	1,114	25.0
26. Pao-Hsin.....	1,679	56	3.0
27. Kuan-Hsien.....	989	692	70.0
28. Peng-Hsien.....	895	627	70.0
29. Shih-Feng.....	746	597	80.0
30. Mien-Chu.....	638	510	80.0
31. Lo-Chiang.....	699	489	70.0
32. Mien-Yang.....	1,565	1,174	75.0
33. Tzu-Tung.....	595	208	35.0
34. Nan-Pu.....	2,922	979	33.0
35. Nan-Chung.....	1,481	518	35.0
36. I-Lung.....	1,578	394	25.0
37. Ying-Shan.....	1,764	648	37.0
38. Ta-Hsien.....	3,549	1,242	35.0
39. Kai-Chiang.....	1,040	624	60.0
40. Wan-Hsien.....	3,667	2,200	60.0
41. Tsung-Nai.....	1,503	1,052	69.0
42. Ta-I.....	1,081	757	70.0
43. Tsung-Ching.....	1,116	837	75.0
44. Wen-Chiang.....	251	213	85.0
45. Tsung-Nin.....	178	151	85.0
46. Pi-Hsien.....	273	232	85.0
47. Sin-Fang.....	159	116	73.0

TABLE 2—Continued

Name of District	Total Land Area (In Sq.Kilo-meter)	Total Cultivated Area (In Sq.Kilo-meter)	Ratio of (3) to (2) in Per Cent
48. Sin-Tu.....	344	236	70.0
49. Kuang-Han.....	499	399	80.0
50. Te-Yang.....	512	410	80.0
51. Chung-Chiang.....	2,458	1,615	66.0
52. San-Tai.....	2,733	1,366	50.0
53. Yen-Ting.....	595	208	35.0
54. Si-Chung.....	999	749	75.0
55. Nan-Chung.....	2,636	1,978	75.0
56. Peng-An.....	1,638	1,147	70.0
57. Chu-Hsien.....	1,657	647	39.0
58. Ta-Chu.....	1,826	913	50.0
59. Liang-Shan.....	2,408	1,686	70.0
60. Chung-Hsien.....	1,569	785	50.0
61. Shih-Chu.....	2,071	632	31.0
62. Ming-Shan.....	622	159	26.0
63. Pu-Chiang.....	501	320	64.0
64. Sin-Tsing.....	316	268	85.0
65. Peng-Shan.....	425	298	70.0
66. Shuan-Liu.....	288	244	85.0
67. Hua-Yang.....	957	813	85.0
68. Cheng-Tu.....	246	208	80.0
69. Ching-Tan.....	1,411	1,129	80.0
70. Chien-Yang.....	2,502	1,501	60.0
71. Lo-Chi.....	1,158	810	70.0
72. Siu-Ning.....	1,814	1,451	80.0
73. Peng-Hsi.....	1,974	987	50.0
74. Shei-Hung.....	1,399	1,042	74.0
75. Wu-Cheng.....	1,079	863	80.0
76. Yo-Chi.....	1,859	1,394	75.0
77. Kuang-An.....	1,707	854	50.0
78. Liang-Shui.....	1,897	894	47.0
79. Tien-Chiang.....	8,865	597	6.8
80. Feng-Tu.....	858	478	56.0
81. Peng-Shui.....	9,131	1,117	15.0
82. Chien-Chiang.....	2,237	336	15.0
83. Yu-Yang.....	3,665	1,078	29.0
84. Siu-Shan.....	1,440	432	30.0
85. Tang-Ling.....	724	289	40.0
86. Mei-Shan.....	1,035	517	50.0
87. Jen-Shou.....	2,516	1,510	60.0
88. Tzu-Yang.....	1,733	1,213	70.0
89. An-Yo.....	2,768	1,661	60.0
90. Tung-Nan.....	1,751	1,225	70.0
91. Ho-Chuan.....	2,840	1,989	70.0
92. Chiang-Pei.....	2,472	1,730	70.0
93. Chang-Sheo.....	1,138	667	58.0
94. Pei-Ling.....	5,520	3,312	60.0
95. Hung-Ya.....	1,523	228	15.0
96. Chia-Chiang.....	420	128	31.0
97. Ching-Shen.....	409	205	50.0

TABLE 2—Continued

Name of District	Total Land Area (In Sq.Kilo-meter)	Total Cultivated Area (In Sq.Kilo-meter)	Ratio of (3) to (2) in Per Cent
98. Ching-Yen.....	628	408	65.0
99. Yung-Hsien.....	1,965	786	40.0
100. Wei-Yuan.....	781	482	60.0
101. Tzu-Chung.....	1,905	1,324	70.0
102. Lei-Chiang.....	1,599	1,119	70.0
103. Yung-Chang.....	899	629	70.0
104. Ta-Cho.....	1,316	658	50.0
105. Tung-Liang.....	1,497	898	60.0
106. Pih-Shan.....	8,111	568	7.0
107. Pa-Hsien.....	3,312	1,656	50.0
108. Nan-Chuan.....	3,029	382	13.0
109. O-Pien.....	2,738	237	9.0
110. O-Mei.....	1,272	367	29.0
111. Lo-Shan.....	1,867	933	50.0
112. Chien-Wei.....	1,954	684	35.0
113. I-Ping.....	4,230	2,961	70.0
114. Fu-Shun.....	2,207	1,544	70.0
115. Lung-Chang.....	761	496	66.0
116. Lu-Hsien.....	2,913	2,185	75.0
117. Yung-Chuan.....	1,288	902	70.0
118. Chiang-Tsin.....	3,253	1,626	50.0
119. Chi-Chiang.....	1,839	276	15.0
120. Lei-Po.....	4,814	481	10.0
121. Ma-Pien.....	2,624	136	5.0
122. Ping-Shan.....	2,891	848	29.0
123. Kao-Hsien.....	1,394	120	9.0
124. Ching-Fu.....	1,077	538	50.0
125. Nan-Hsi.....	957	680	75.0
126. Chiang-An.....	740	447	60.0
127. Nou-Hsi.....	477	344	72.0
128. Ho-Chiang.....	2,329	797	34.0
129. Yung-Lien.....	342	122	36.0
130. Chi-Hsien.....	1,197	104	9.0
131. Chang-Ning.....	1,295	307	24.0
132. Hsing-Wen.....	526	195	37.0
133. Ku-Sung.....	598	167	28.0
134. Siu-Yung.....	2,916	114	4.0
135. Ku-Ning.....	5,589	381	7.0
136. Sung-Pan.....	50,139	20	0.04
Total.....	360,159	100,787	28.9

TABLE 3
CLIMATIC DATA OF CHENG TU AND CHUNGKING

Month	Average Monthly Tempera- ture (In Cent.)	Total Pre- cipitation by Month (In Mm.)	Frequency of Rain (Days)	Humidity (o/o)	Wind Velocity M.S.
Chengtu (1929-1939)					
January..	5.5	5.1	4	80	1.22
February..	6.6	8.1	5	79	1.37
March....	14.5	8.6	4	76	1.61
April....	19.3	50.0	9	77	1.35
May.....	23.5	58.2	9	74	1.59
June.....	25.7	104.6	13	76	1.63
July.....	26.7	224.4	12	80	1.47
August...	26.8	230.5	12	82	1.48
September	21.6	130.1	16	84	1.06
October..	18.3	50.2	14	82	1.16
November.	13.8	10.2	4	83	.87
December.	7.2	4.6	2	81	.67
Total..	17.5	884.6	104	80	1.29
Chungking (1913-1939)					
January..	8.8	16.9	8	80	1.1
February..	9.9	17.3	10	80	1.1
March....	14.3	31.1	12	74	1.3
April....	19.7	91.1	16	77	1.3
May.....	23.0	103.2	16	76	1.3
June.....	25.6	172.8	19	76	1.2
July.....	28.2	144.2	12	73	1.1
August...	29.2	102.6	10	69	.9
September	23.3	140.1	16	74	1.0
October..	18.3	124.7	20	82	1.1
November.	14.7	57.2	13	85	1.1
December.	10.2	23.7	10	84	1.1
Total..	18.8	1024.9	162	78	1.2

TABLE 4
PRODUCTION OF COTTON IN SZECHUAN (1936)

Name of District	Cultivated Area (In Mow)	Total Production (In Piculs)	Percentage of Total Production
Sui-Ning.....	387,335	60,374	20.1
Shei-Hung.....	322,380	59,458	19.8
Jen-Shou.....	275,416	26,025	8.6
San-Tai.....	146,318	23,670	7.8
I-Lung.....	120,309	17,265	5.7
Nan-Pu.....	114,226	15,318	5.1
Chien-Yang.....	118,950	15,249	5.0
Pa-Chung.....	76,747	15,082	5.0
Chung-Chiang....	79,402	12,480	4.1
Yen-Ting.....	123,710	10,272	3.4
Yung-Hsien.....	49,448	7,063	2.3
Lo-Chi.....	36,676	6,693	2.2
Ching-Tan.....	59,876	5,389	1.7
Peng-Hsi.....	25,628	3,692	1.2
Fu-Shun.....	24,683	3,393	1.1
Nan-Chung.....	7,500	2,653	.8
Tung-Nan.....	19,960	1,996	.6
Wei-Yuan.....	17,860	1,917	.6
Feng-Chieh.....	6,800	1,623	.5
Lu-Hsien.....	19,958	1,605	.5
Yun-Yang.....	1,025	1,544	.5
Peng-An.....	14,596	1,167	.3
Ho-Chiang.....	3,450	1,158	.3
Tzu-Yuang.....	13,725	945	.3
Chiang-An.....	11,492	864	.2
Nan-Ch'ung.....	6,424	628	.2
Tzu-Chung.....	7,179	527	.1
An-Yo.....	1,677	352	.1
Si-Chung.....	6,008	324	.1
I-Ping.....	5,000	300	.09
Lo-Chiang.....	3,725	267	.08
Nou-Hsi.....	993	187	.06
Chang-Ning.....	3,000	168	.05
Ching-Fu.....	440	147	.04
Nan-Hsi.....	1,889	113	.03
Ching-Yen.....	1,474	98	.03
Lei-Chiang.....	1,416	97	.03
Chien-Wei.....	1,520	97	.03
Lung-Chang.....	792	44	.01
Chia-Chiang.....	408	35	.01
Total.....	2,119,415	300,279	100.00

TABLE 5
RAINFALL CONDITIONS OF SUINING (COTTON
PRODUCING CENTER) SZECHUAN
(1936-1937 Average)

Month	Amount of Rain (In Mm.)	Average Number of Days			
		Clear	Partly Cloudy	Cloudy	Rainy
January.....	4.7	3	13	12	5
February.....	14.5	5	3	15	5
March.....	21.8	4	16	4	7
April.....	44.4	7	8	7	13
May.....	86.5	1	10	5	15
June.....	108.5	2	5	5	18
July.....	201.5	3	7	7	14
August.....	227.0	3	6	4	18
September.....	146.0	1	2	4	23
October.....	52.6	4	2	11	14
November.....	11.3	4	9	12	5
December.....	10.9	3	4	16	8
Total.....	929.7	40	85	102	145

TABLE 6
PRODUCTION OF TOBACCO IN SZECHUAN (1936)

Name of District	Total Amount (In Piculs)	Per Cent of Total
Shih-Fang.....	290,000	48.3
Pi-Hsien.....	80,079	13.3
Mien-Chu.....	75,000	12.5
Sin-Tu.....	45,578	7.6
Wen-Chiang.....	40,000	6.6
Tsung-Nin.....	15,000	2.5
Chung-Hsien.....	6,300	1.5
Ching-Tang.....	6,000	1.0
Ta-Hsien.....	5,473	.9
Sin-Fang.....	4,900	.8
Yun-Yang.....	4,500	.7
Tung-Nan.....	4,500	.7
Sui-Ning.....	3,500	.5
Chia-Chiang.....	3,500	.5
Kuan-Hsien.....	2,300	.3
Chi-Chiang.....	1,600	.2
Chu-Hsien.....	1,590	.2
Siu-Shan.....	1,360	.2
Mei-Shan.....	1,250	.2
Te-Yang.....	1,200	.2
Nou-Hsi.....	800	.1
Liang-Shan.....	750	.1
Peng-Hsi.....	700	.1
Cheng-Tu.....	426	.07
Chung-Ching.....	410	.06
Chiang-An.....	400	.06
Peng-An.....	400	.06
Hsin-Wen.....	300	.05
Yung-Lien.....	300	.05
Nan-Hsi.....	200	.03
Kao-Hsien.....	200	.03
Pa-Hsien.....	120	.02
Ching-Yen.....	120	.02
Kai-Chiang.....	120	.02
Wu-Sheng.....	115	.01
Chien-Wei.....	100	.01
Hsuan-Han.....	100	.01
Chien-Chiang.....	30	.005
Total.....	599,221	100.000

TABLE 7
SUGAR PRODUCTION IN SZECHUAN (1936)

Name of District	Total Production (In Piculs)	Per Cent of Total
Nei-Chiang.....	625,000	24.6
Tzu-Chung.....	625,000	24.6
Chien-Yang.....	225,000	8.8
Fu-Shun.....	200,000	7.9
Tzu-Yang.....	175,000	6.9
Chu-Hsien.....	100,000	3.9
I-Ping.....	70,000	2.9
Ching-Tang.....	60,000	2.3
Nan-Hsi.....	50,000	1.9
Te-Yang.....	50,000	1.9
Wei-Yuan.....	48,900	1.9
Lung-Chang.....	37,500	1.4
Kuang-Han.....	30,000	1.1
Jen-Shou.....	27,225	1.0
Kuang-An.....	25,000	.9
Tsung-Nai.....	25,000	.9
Chien-Wei.....	24,250	.9
	15,000	.5
Mei-Shan.....	10,000	.3
Sui-Ning.....	10,000	.3
Shih-Fang.....	10,000	.3
Sin-Tsing.....	8,000	.3
Ching-Fu.....	7,900	.3
Lu-Hsien.....	7,500	.2
Chi-Hsien.....	7,500	.2
Yung-Hsien.....	6,500	.2
Chiang-An.....	5,000	.1
Kai-Hsien.....	5,000	.1
Kao-Hsien.....	3,000	.1
Nou-Hsi.....	3,000	.1
Ho-Chuan.....	3,000	.1
Wan-Hsien.....	3,000	.1
Chiang-Tsin.....	2,800	.1
Ping-Shan.....	2,500	.09
Chang-Ning.....	2,500	.09
Ching-Shen.....	2,400	.09
Wu-Sheng.....	2,375	.09
Lo-Chiang.....	1,875	.09
Peng-Shan.....	1,795	.06
Lei-Po.....	1,650	.06
Tung-Nan.....	1,547	.06
Ho-Chiang.....	1,500	.06
Mien-Chu.....	1,400	.05
Yo-Chi.....	1,250	.04
Tung-Liang.....	1,000	.03
Total.....	2,526,867	100.00

TABLE 8
CLIMATIC CONDITIONS OF TOBACCO-PRODUCING
CENTERS OF SZECHUAN
(1936-1938 Average)

Name of District	Climatic Conditions	Jan.	Feb.	March	April	May
Mei-Shan.....	Temperature (C.)	12.7	14.8	15.2	20.9	23.9
	Humidity (o/o)	77.8	76.1	69.3	68.6	75.0
	Rainfall (mm.)	3.0	....	32.0	56.8	108.5
Lo-Shan.....	Temperature (C.)	7.4	10.2	14.8	19.4	23.3
	Humidity (o/o)	70.1	70.0	58.9	64.6	64.8
	Rainfall (mm.)	1.6	15.0	15.9	64.5	141.2
Chia-Chiang.....	Temperature (C.)	8.6	11.2	....	20.7	28.9
	Humidity (o/o)	75.2	79.0	....	75.5	75.0
	Rainfall (mm.)	2.8	4.7	....	31.0	51.1
Wen-Chiang.....	Temperature (C.)	5.8	9.1	12.6	18.7	22.4
	Humidity (o/o)	77.4	75.8	72.4	72.0	71.7
	Rainfall (mm.)	8.2	23.0	9.3	4.8	102.0
Sin-Tu.....	Temperature (C.)	6.9	9.3	13.3	....	....
	Humidity (o/o)	88.9	....	....	....	....
	Rainfall (mm.)	2.0	11.4	5.6	85.0	112.5
Ching-Tan.....	Temperature (C.)	....	7.1	....	....	....
	Humidity (o/o)	....	....	....	....	....
	Rainfall (mm.)	....	14.3	....	29.7	....
Mien-Chu.....	Temperature (C.)	....	8.6	13.2	18.2	....
	Humidity (o/o)	....	81.1	73.0	71.0	....
	Rainfall (mm.)	....	4.0	15.7	24.2	....
Te-Yang.....	Temperature (C.)	6.3	10.1	14.6	19.9	24.1
	Humidity (o/o)	81.1	73.2	64.6	62.7	66.8
	Rainfall (mm.)	11.0	10.3	3.0	27.6	94.9
Shih-Fang.....	Temperature (C.)	....	....	....	19.1	22.7
	Humidity (o/o)	....	....	....	81.2	77.0
	Rainfall (mm.)	....	....	....	21.5	118.6
Pi-Hsien.....	Temperature (C.)	6.1	7.8	14.0	18.8	22.9
	Humidity (o/o)	75.5	75.6	72.9	70.9	73.5
	Rainfall (mm.)	.2	10.5	9.8	31.6	145.3

TABLE 8—Continued

June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average
26.5	27.9	27.6	24.4	21.3	15.2	9.4	233.2	19.4
77.8	82.1	70.4	79.9	76.5	73.2	78.1	904.2	75.4
124.1	354.0	366.2	41.3	7.4	1.9	12.8	1047.7	....
24.0	26.1	26.4	22.1	18.7	12.1	9.0	203.5	17.7
75.6	70.2	82.3	84.6	79.1	75.1	80.5	885.1	73.7
81.6	166.4	52.1	216.9	89.1	20.0	21.8	.....	....
24.8	27.5	27.7	23.7	19.1	12.8	9.5	.....	....
77.3	78.5	86.1	.....	.....	82.7	88.9	.....	....
101.3	205.7	220.7	116.9	42.2	16.9	40.3	.....	....
24.3	20.0	26.7	22.0	18.2	10.6	3.4	204.8	17.1
78.3	81.8	81.3	82.8	80.9	78.6	76.0	929.0	77.4
161.2	461.6	172.0	205.0	86.4	18.5	9.5	1221.6	....
.....	.....	.....	.....	.....	.....	8.6	.....	....
.....	.....	.....	.....	.....	.....	58.4	.....	....
70.0	368.0	126.7	217.5	25.0	3.0	....	1027.5	....
25.1	26.5	.....	22.5	18.5	11.5	8.8	.....	....
78.2	77.7	.....	84.3	80.8	81.3	85.5	.....	....
27.5	263.4	.....	111.5	28.6	5.3	15.0	.....	....
24.3	26.9	27.6	21.5	17.8	10.4	6.6	.....	....
81.9	85.5	84.5	80.8	87.2	88.5	....	.....	....
88.6	424.1	318.7	157.8	44.7	26.9	....	.....	....
21.9	25.4	29.0	22.2	19.0	13.5	9.3	218.3	18.2
78.9	75.1	73.5	80.3	....	77.8	79.3	.....	....
78.0	28.8	67.2	12.8	....	15.2	13.4	.....	....
23.9	25.9	27.3	22.2	18.4	10.8	8.7	.....	....
82.9	81.6	82.4	84.6	79.8	78.3	78.6	.....	....
144.6	48.2	155.1	239.5	21.3	24.0	5.1	.....	....
24.6	25.8	27.1	21.7	18.1	11.5	8.3	260.7	17.2
80.4	83.2	83.4	83.8	82.5	81.9	80.0	943.6	78.6
134.9	311.1	515.1	245.0	30.5	11.8	9.7	1455.5	....

TABLE 9
CLIMATIC CONDITIONS OF THE HEMP-PRODUCING DISTRICTS
OF SZECHUAN
(1936-1938 Average)

Name of District	Climatic Conditions	Jan.	Feb.	March	April	May
Wen-Chiang.....	Temperature (C.)	5.8	9.1	12.6	18.7	22.4
	Humidity (o/o)	77.4	75.8	72.4	72.6	71.7
	Rainfall (mm.)	8.2	23.0	9.3	4.8	102.0
Tsung-Ching.....	Temperature (C.)	....	....	....	....	24.6
	Humidity (o/o)	....	....	....	....	79.8
	Rainfall (mm.)	....	....	....	....	40.0
Kuan-Hsien.....	Temperature (C.)	....	....	....	19.4	22.7
	Humidity (o/o)	....	....	....	65.3	63.1
	Rainfall (mm.)	....	....	....	49.6	100.8
Pi-Hsien.....	Temperature (C.)	6.1	7.8	14.0	18.8	22.9
	Humidity (o/o)	75.5	75.6	72.9	70.9	78.5
	Rainfall (mm.)	.2	10.5	9.8	31.6	145.3
Shuan-Liu.....	Temperature (C.)	6.6	8.3	13.6	18.7	23.0
	Humidity (o/o)	89.8	84.6	75.3	76.4	79.1
	Rainfall (mm.)	.5	10.7	7.1	31.1	70.0
Sin-Tsing.....	Temperature (C.)	....	....	....	....	....
	Humidity (o/o)	....	....	....	....	....
	Rainfall (mm.)	....	....	....	....	....
Peng-Hsien.....	Temperature (C.)	5.9	....	....	....	24.6
	Humidity (o/o)	89.5	....	....	....	66.5
	Rainfall (mm.)	.8	....	....	....	137.2
Tsung-Ning.....	Temperature (C.)	5.6	8.7	12.4	18.3	22.4
	Humidity (o/o)	82.8	84.7	82.1	79.5	79.8
	Rainfall (mm.)	5.4	6.6	20.2	11.3	160.5

TABLE 9—Continued

June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average
24.3	26.0	26.7	22.0	18.0	10.6	8.4	204.8	17.1
78.3	81.8	81.8	82.8	80.9	78.6	76.0	929.0	77.4
161.2	461.6	172.0	205.0	46.4	18.5	9.5	1221.6	....
25.6	27.0	27.5	22.9	19.3	11.6	9.1	.....	....
84.4	88.3	.....	.....	81.3	83.9	80.7	.....	....
54.0	440.0	.....	446.7	150.1	51.2	10.7	.....	....
24.6	25.4	26.9	20.7	19.4	12.2	7.8	.....	....
71.1	79.4	.....	85.9	.....	69.6	66.5	.....	....
188.2	878.7	456.5	244.6	187.7	57.3	32.3	.....	....
24.6	25.8	27.1	21.7	18.1	11.5	8.3	206.7	17.2
80.4	83.2	83.4	83.8	82.5	81.9	80.0	943.6	78.6
184.9	311.1	515.1	245.0	30.5	11.8	9.7	1455.5	....
24.8	25.8	27.2	22.3	18.4	11.4	8.7	208.8	17.4
86.6	.....	87.6	88.5	86.0	85.2	88.3	.....	....
51.2	447.8	197.2	163.7	45.2	10.6	7.8	1042.0	....
26.4	27.1	28.0	23.2	19.1	11.9	9.3	.....	....
74.2	80.5	79.8	83.1	77.5	75.5	79.7	.....	....
106.9	378.5	337.1	175.9	34.4	16.0	17.4	.....	....
23.5	28.6	27.5	22.2	17.8	10.9	9.0	.....	....
78.9	72.8	.....	84.5	84.6	79.8	82.0	.....	....
53.0	46.7	54.0	76.3	20.9	17.3	5.5	.....	....
23.8	25.6	27.5	22.6	18.5	10.5	8.6	.....	....
85.7	.....	87.8	.....	88.2	88.6	81.9	.....	....
89.7	168.3	69.5	82.8	70.6	13.8	23.2	.....	....

TABLE 10
PRODUCTION OF CITRUS FRUITS IN SZECHUAN (1936)

Name of District	Cultivated Area (Mow)	Number of Trees	Total Amount of Production (Pieces)	Per Cent
Ho-Chuan.....	13,366	410,000	45,200,000	22.3
Chiang-Tsin.....	8,334	200,000	36,200,000	17.8
Pa-Hsien.....	8,500	170,000	23,500,000	11.5
Ching-Tang.....	7,611	195,000	20,300,000	10.0
Chang-Shou.....	8,200	160,000	15,050,000	7.4
Nei-Chiang.....	3,000	60,000	12,000,000	5.9
Wan-Hsien.....	2,334	56,000	10,000,000	4.9
Tzu-Yang.....	2,400	40,000	9,000,000	4.4
Tzu-Chung.....	2,000	40,000	7,500,000	3.7
Chien-Yang.....	1,000	20,000	5,000,000	2.4
Feng-Hsi.....	2,500	60,000	4,030,000	1.9
I-Ping.....	3,824	15,000	4,000,000	1.9
Nan-Chung.....	3,000	60,000	3,600,000	1.7
Kuang-Han.....	1,000	20,000	2,000,000	.9
Chu-Hsien.....	500	10,000	2,000,000	.9
Lu-Hsien.....	500	10,000	2,000,000	.9
Tien-Chiang.....	650	16,000	280,000	.1
Feng-Chieh.....	127	2,046	170,000	.08
Sui-Ning.....	250	5,000	120,000	.05
Pih-Shan.....	200	5,000	100,000	.04
Lung-Chang.....	126	2,500	80,000	.03
Ta-Chu.....	100	3,000	50,000	.02
Total.....	69,522	1,559,546	202,180,000	100.00

TABLE 11
PRODUCTION OF TEA IN SZECHUAN (1936)

Name of District	Total Amount (In Piculs)	Per Cent of Total
Ya-An.....	20,000	17.3
Kuan-Hsien.....	16,452	14.2
Ta-I.....	12,000	10.4
Pai-Chuan.....	10,800	9.3
Ho-Chiang.....	10,000	8.6
Yung-Ching.....	10,000	8.6
Kao-Hsien.....	6,000	5.1
Tsung-Nai.....	5,000	4.3
Cheng-Ko.....	3,000	2.5
Yung-Lien.....	2,500	2.1
Ping-Shan.....	2,000	1.7
Wan-Yuan.....	2,000	1.7
Tien-Chuen.....	1,700	1.4
An-Hsien.....	1,600	1.3
Chi-Chiang.....	1,500	1.2
Ping-Wu.....	1,500	1.2
Ching-Shen.....	1,500	1.2
Chien-Wei.....	1,500	1.2
Liang-Shan.....	1,320	1.1
O-Mei.....	1,050	.9
Ma-Pien.....	955	.8
Ta-Hsien.....	500	.4
Nan-Chuan.....	500	.4
Chia-Chiang.....	500	.4
Mien-Chu.....	300	.2
Yung-Hsien.....	214	.1
Hsing-Wen.....	200	.1
Hsuan-Han.....	200	.1
Tung-Liang.....	120	.1
Chien-Chiang.....	85	.07
O-Pien.....	80	.07
Chung-Hsien.....	78	.06
Han-Yuan.....	60	.05
Kuang-An.....	54	.04
Tien-Chiang.....	40	.03
Chang-Ning.....	35	.03
Nou-Hsi.....	30	.02
Kai-Chiang.....	25	.02
Ming-Shan.....	20	.01
Pu-Chiang.....	20	.01
Siu-Shan.....	16	.01
Tang-Ling.....	4	.003
Wen-Chuan.....	3	.002
Total.....	115,461	100.000

TABLE 12
PRODUCTION OF SILK IN SZECHUAN (1936)

Name of District	Total Amount of Production (In Piculs)	Per Cent of Total
Lo-Shan.....	1,834	21.4
San-Tai.....	1,000	11.7
Si-Chung.....	986	11.5
Ho-Chuan.....	952	11.1
Tung-Liang.....	900	10.5
Fu-Shun.....	443	5.1
Shei-Hung.....	400	4.6
Hung-Ya.....	313	3.6
Ching-Shen.....	313	3.6
Lan-Chung.....	300	3.5
Chi-Hsien.....	227	2.6
Yung-Lien.....	200	2.3
Nan-Ch'ung.....	156	1.8
Tzu-Tung.....	110	1.2
Mien-Yang.....	87	1.0
Chien-Wei.....	80	.9
Han-Yuan.....	80	.9
Tang-Ling.....	50	.5
Ping-Shan.....	38	.4
Ma-Pien.....	14	.1
O-Mei.....	13	.1
Ho-Chiang.....	13	.1
Chao-Hua.....	12	.1
Kao-Hsien.....	11	.1
Total.....	8,532	100.0

TABLE 13

PRODUCTION OF TUNG OIL IN SZECHUAN (1936)

Name of District	Total Amount (In Piculs)	Per Cent of Total
Ning-Shui.....	185,000	24.2
Chung-Hsien.....	140,000	18.3
Yun-Yang.....	100,000	13.1
Wan-Hsien.....	60,000	7.8
Siu-Shan.....	50,000	6.5
Feng-Tu.....	40,000	5.5
Feng-Chieh.....	20,000	2.6
Fu-Hsi.....	10,000	1.3
Liang-Shan.....	10,000	1.3
Chang-Shou.....	10,000	1.3
Shih-Chu.....	10,000	1.3
Pei-Ling.....	10,000	1.3
Ho-Chuan.....	8,000	1.0
Yu-Yang.....	8,000	1.0
Hsuan-Han.....	6,000	.7
Lu-Hsien.....	6,000	.7
Ta-Chu.....	6,000	.7
Fu-Shan.....	5,000	.6
Kai-Hsien.....	5,000	.6
Tien-Chiang.....	5,000	.6
Nan-Chuan.....	5,000	.6
Kai-Chiang.....	4,000	.5
Wu-Sheng.....	4,000	.5
Ta-Hsien.....	4,000	.5
I-Ping.....	4,000	.5
Lo-Shan.....	4,000	.5
Ping-Shan.....	4,000	.5
Chiang-Tsin.....	3,000	.3
Ho-Chiang.....	3,000	.3
Chu-Hsien.....	3,000	.3
Yen-Ting.....	3,000	.3
Si-Chung.....	3,000	.3
Kuang-An.....	3,000	.3
Wan-Yuan.....	3,000	.3
Nan-Chung.....	3,000	.3
Yung-Hsien.....	2,000	.2
Pa-Hsien.....	2,000	.2
Chiang-Yu.....	2,000	.2
Siu-Ning.....	2,000	.2
Peng-Hsi.....	2,000	.2
Nan-Pu.....	2,000	.2
Peng-Shui.....	1,000	.1
Chien-Chiang.....	1,000	.1
Chi-Chiang.....	1,000	.1
Total.....	762,000	100.0

TABLE 14
PRODUCTION OF SALT IN SZECHUAN (1936)

Name of District	Total Production (In Piculs)	Per Cent of Total Production
Fu-Sun-Yung-Chang.....	3,674,365	51.2
Chien-Wei.....	684,534	9.5
Lo-Shan.....	464,508	6.4
Yun-Yang.....	408,367	5.6
Nan-Pu-Nan-Chung.....	248,130	3.4
Shei-Hung-Peng-Hsi.....	218,050	3.0
San-Tai.....	211,124	2.9
Peng-Hsi.....	206,252	2.8
Lo-Chi.....	181,389	2.5
Shei-Hung.....	134,690	1.8
Sui-Ning.....	133,039	1.8
Ching-Yen.....	119,349	1.6
Mien-Yang.....	108,816	1.5
Si-Chung.....	64,814	.9
Yen-Ting.....	55,118	.7
Chien-Yang.....	55,051	.7
Feng-Chieh.....	51,313	.7
Tzu-Chung.....	43,035	.5
Kai-Hsien.....	39,775	.5
Peng-Shui.....	32,675	.4
Chung-Chiang.....	27,553	.3
Chung-Hsien.....	8,827	.1
Ta-Cho.....	3,799	.05
Total.....	7,174,572	100.00

A P P E N D I X I I

INDEX OF NAMES OF DISTRICTS (HSIEN) OF SZECHUAN
BASIN (ARRANGED ALPHABETICALLY)

<u>Name of District</u>	<u>Index No. on Figure 11</u>	<u>Name of District</u>	<u>Index No. on Figure 11</u>
An-Hsien.....	16	Fu-Shun.....	114
An-Yo.....	89	Ho-Chiang.....	128
Chang-Ming.....	17	Ho-Chuan.....	91
Chang-Ning.....	131	Hsin-Wen.....	132
Chang-Sheo.....	93	Hsuan.....	22
Chao-Hua.....	6	Hua-Yang.....	67
Cheng-Ko.....	11	Hung-Ya.....	95
Cheng-Tu.....	68	I-Lung.....	36
Chi-Chiang.....	119	I-Ping.....	113
Chi-Hsien.....	130	Jen-Shou.....	87
Chia-Chiang.....	96	Kai-Chiang.....	39
Chiang-An.....	126	Kai-Hsien.....	23
Chiang-Pei.....	92	Kao-Hsien.....	123
Chiang-Tsin.....	118	Ku-Ning.....	135
Chiang-Yu.....	18	Ku-Sung.....	133
Chien-Chiang.....	82	Kuan-Hsien.....	27
Chien-Ko.....	19	Kuang-An.....	77
Chien-Wei.....	112	Kuang-Han.....	49
Chien-Yang.....	70	Kuang-Yuan.....	7
Ching-Fu.....	124	Lan-Chung.....	35
Ching-Hua.....	1	Lei-Po.....	120
Ching-Shen.....	97	Li-Fang.....	2
Ching-Tang.....	69	Liang-Shan.....	59
Ching-Yen.....	98	Lo-Chi.....	71
Chu-Hsien.....	57	Lo-Chiang.....	31
Chung-Chiang.....	51	Lo-Shan.....	111
Chung-Hsien.....	60	Lu-Hsien.....	116
Feng-Chieh.....	25	Lung-Chang.....	115
Feng-Tu.....	80	Ma-Pien.....	121
Fu-Hsi.....	12	Mei-Shan.....	86
Fu-Shan.....	13	Miao-Hsien.....	3

<u>Name of District</u>	<u>Index No. on Figure 11</u>	<u>Name of District</u>	<u>Index No. on Figure 11</u>
Miao-Kung.....	14	Sin-Tu.....	48
Mien-Chu.....	30	Siu-Shan.....	84
Mien-Yang.....	32	Sui-Ning.....	72
Ming-Shan.....	62	Sui-Yung.....	134
Nan-Chiang.....	8	Sung-Pan.....	136
Nan-Chuan.....	108	Ta-Cho.....	104
Nan-Chung.....	55	Ta-Chu.....	58
Nan-Hsi.....	125	Ta-Hsien.....	38
Nan-Pu.....	34	Ta-I.....	42
Nei-Chiang.....	102	Tang-Ling.....	85
Ning-Shui.....	78	Te-Yang.....	50
Nou-Hsi.....	127	Tien-Chiang.....	79
O-Mei.....	110	Tsang-Hsi.....	20
O-Pien.....	109	Tsung-Ching.....	43
Pa-Chung.....	21	Tsung-Nai.....	41
Pa-Hsien.....	107	Tsung-Nin.....	45
Pao-Hsien.....	26	Tung-Chiang.....	9
Pei-Chuan.....	4	Tung-Liang.....	105
Pei-Ling.....	94	Tung-Nan.....	90
Peng-An.....	56	Tzu-Chung.....	101
Peng-Hsi.....	73	Tzu-Tung.....	33
Peng-Hsien.....	28	Tzu-Yang.....	88
Peng-Shan.....	65	Wan-Hsien.....	40
Peng-Shui.....	81	Wan-Yuan.....	10
Pi-Hsien.....	46	Wei-Yuan.....	100
Pih-Shan.....	106	Wen-Chiang.....	44
Ping-Shan.....	122	Wen-Chuan.....	15
Ping-Wu.....	5	Wu-Sheng.....	75
Pu-Chiang.....	63	Yen-Ting.....	53
Sen-Tai.....	52	Ying-Shan.....	37
Shei-Hung.....	74	Yo-Chi.....	76
Shih-Chu.....	61	Yu-Yang.....	83
Shih-Fang.....	29	Yun-Lien.....	129
Shuan-Liu.....	66	Yun-Yang.....	24
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